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MARKET STREET, WILMINGTON, DEL. BITULITHIC PAVEMENT WITH STONE BETWEEN STREET RAILWAY TRACKS.

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Engineers are the votaries of an art which has for its object the furthering of things and methods that serve for the use and convenience of man. They should make that object the aim of the direct tendency of their work and the criterion of its fitness for the exercise of their energies.—Clemens Herschel.

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STREET LIGHTING PRACTICE

WITH INCANDESCENT LAMPS

By G. H. Stickney, Harrison, N. J.

This carefully prepared discussion of the use of modern incandescent lamps in street lighting is by an expert who is familiar with all the problems arising in connection with the installation of a system of electric street lighting. It is part of a paper prepared for the American Society of Municipal Improvements and lays down the principles which have been developed, the illustrations giving examples of some details of installations.

IN the lighting of a modern American city, one encounters a range of practice varying, step by step, from the dim lighting in the outlying districts to the brilliant lighting of the main central thorofares. This typifies, in a way, the historical progress of the art from the time the best street lighting consisted merely of beacons to guide the travelers, up to the present standard of ornamental street lighting. Nor has the practice shown an indication of having reached an ultimate standard. On the contrary, the rate of advance at the present time seems to be more rapid than ever before. Never has the value of good street illumination been so highly appreciated, while the recent improvements in illuminants, tending toward the economical production and utilization of light, seem likely to result in raising the standard rather than in reducing the cost to any great extent.

The history of street lighting indicates that better lighting follows closely on the availability of improved illuminants. As an example of this, we may note the advances which followed when the open arc became available about 1878; the enclosed arc about 1895; the luminous arc about 1904, and the tungsten filament incandescent lamp about 1907.

Purpose.—While the purpose of street lighting has been discussed frequently, it is desirable that we have clearly in mind the purpose of the illumination.

For ordinary or utility street lighting, the main purpose is to permit the traveler to pursue his way with safety and convenience. In outlying roads, the lighting may serve merely as a guide to enable the traveler to keep on the road. In city lighting, it is important that one be enabled to avoid irregularities in the street, as well as collision with others. Where the density of traffic is greater, the danger of collision is correspondingly increased, and hence clear and quick vision is more necessary.

Nowadays, thanks to the extension of street lighting, we hear less about the value of street lighting as a protection against persons of evil intent—robbers, highwaymen, etc. Yet we must not overlook the importance of street lighting in the preservation of peace. The extension of good lighting into sections of a city which are subject to disorder, is one of the most effective means of eliminating the evil.

Beyond all this, however, there is another purpose for street lighting, which has developed rapidly in the past decade, and has demanded for certain sections of a city an intensity of illumination which often considerably exceeds that required for safety. The new element of such lighting is the endeavor often made, at considerable expenditure, to render the street more pleasing and attractive. This is the motive of the so-called ornamental or whiteway lighting.

Owing to the influence of the ornamental lighting, this purpose is also now felt to a greater or less degree in ordinary street lighting.

Illumination Effects.—The practice as regards illumination effects may be considered from several distinct standpoints. It is useful to classify the practice, however, with regard to the extent and nature of the illumination, as follows:

(1) Beacon lighting;
(2) Uneven illumination;
(3) Even illumination.

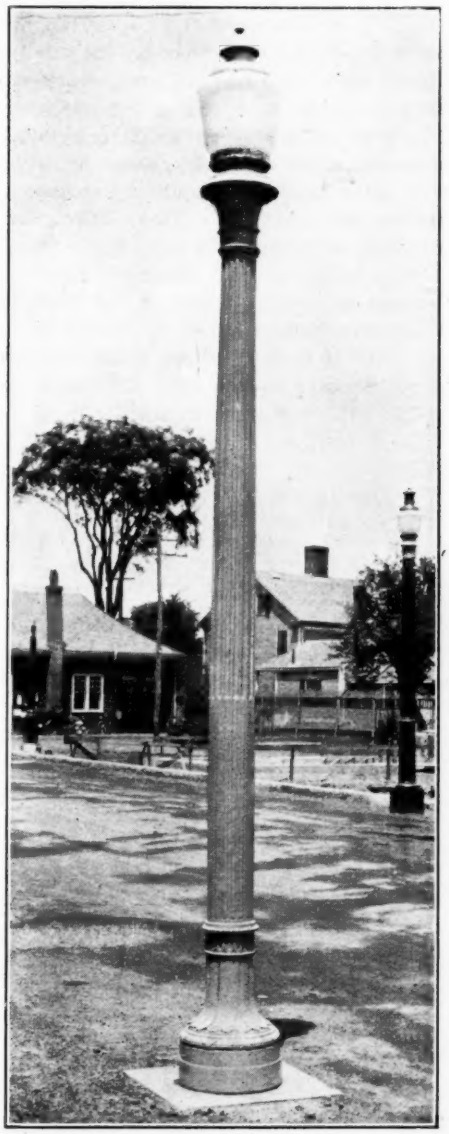
Beacon Lighting.—This character of lighting has already been mentioned. Practically no illumination falls on the roadway, the low intensity lights serving, by their location, to indicate the course of the road, much as a lighthouse and beacons at sea guide the navigators. Such lighting is, of course, inadequate for city streets, but for rural roads, where questions of cost may prohibit the adoption of a higher standard, such lighting will add considerably to the safety of travel; and for such conditions the extension of even this low intensity lighting will be beneficial in developing the country.

Uneven Illumination.—This refers to the practice often observed where areas of streets, near the lamps, are illuminated to a fair intensity, while the intervening sections are but slightly illuminated, and may, in contrast to the illuminated portions, appear to be in absolute darkness. The practice originated thru the early use of arc lamps, especially the open carbon arcs, which, for economy, were spaced at wide intervals—usually at street intersections. At first thought this practice may seem to be entirely unjustified, except on account of the peculiarities of the illuminants, which, in the case mentioned, were inherently of relatively high power.

However, there has been much discussion and difference of opinion on this subject on the part of students of street lighting practice. For certain conditions there seems to be more reason for the practice than would appear on superficial consideration.

Where the intensity of street illumination is very low, large objects, vehicles, etc., are seen in silhouette—usually as dark outlines against an illuminated street surface. Under such conditions experience has shown that such objects can be seen at a much greater distance by the uneven illumination, than if the same total amount of light were evenly distributed.

ORNAMENTAL POLE *top equipment for high-power series Mazda lamps. Three slightly different designs of poles are shown, of various degrees of attractiveness by day and by night.*



Since high power units, widely spaced, cost less per mile of street than low power units at correspondingly narrower intervals, it often happens, where the cost of street lighting must be minimized, that this is the most practicable method of lighting. By locating the light sources over the street at points of street intersections, where the greatest danger of collisions exist, this method is likely to meet the needs of the drivers of vehicles, especially swift-moving automobiles, altho the glare may be objectionable.

The weakest point of this method is that it does not serve the pedestrian on the sidewalk advantageously. Especially where there is dense foliage, or streets are curved and narrow, it is not effective. Where there are irregular intersections of streets, some crossings cannot be properly illuminated without a narrower spacing of lights which may offset the principal advantage, namely, low cost.

Even Lighting.—We commonly refer to a street as evenly lighted if the intensities on the surface do not vary more than, say 10 or 15 to 1. With such lighting the street appears to the ordinary observer to have an even illumination.

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¶ LOW INTENSITY OF LIGHT, *with lamps closer together, produces better appearance of street and more even illumination, and is the more satisfactory for the pedestrian.*

The appearance of the street is very greatly improved with such lighting in contrast to the spotted illumination discussed previously. With higher intensity illumination, it is possible to see better than with corresponding uneven illumination; moreover, the cost is not likely to be much greater.

Classes of Streets.—While street lighting, as already mentioned, is graded by steps from the business center toward the suburbs, it is evident that it is not practicable to have too many steps, lest the lighting system become too complicated for economical operation. The variation usually should not be uniform in all directions, but should depend upon the character and importance of the streets, amount of traffic, etc.

This problem can best be studied by classifying the streets or sections of streets in a small number of groups having similar requirements; and reviewing their needs. Such classification would, of course, vary for different types of cities; for example, it is apparent that street lighting in Manhattan Boro would not typically represent an average American city; and that manufacturing cities would not exactly correspond to residential cities. However, our purposes can be sufficiently served by the following general classification:

(1) Principal business streets;
(2) Ordinary business streets and thorofares;
(3) Residential streets and parkways;
(4) Outlying streets, newly developed sections;
(5) Rural streets and interurban highways.

Whiteway lighting of the principal business streets demands not only the highest intensity of illumination, but diffusion and evenness. The tendency is to provide the maximum illumination opposite the buildings rather than at the street intersections. This is especially true when the lighting is promoted by merchants for advertising purposes. It is, however, good practice, since the illumination on the building front plays an important part in rendering the street attractive; while the illumination at the corners is almost certain to be sufficient for all purposes. Further, since most of this class of lighting employs ornamental lamp posts along the curb, it is often desirable to avoid placing lights at the street corner, as the glare from such a lamp in the eyes of a vehicle driver, who is about to turn a corner and wishes to see beyond, is likely to be more objectionable than the increased light is advantageous.

That the illumination of the building fronts contributes considerably to the cheerful appearance of the street, is evident from the gloomy appearance when the light is cut off from the buildings, even tho the surface of the street is well lighted.

Ordinary business streets, thorofares and residential streets, in which houses

are in blocks and foliage absent, should differ in treatment from the principal streets only in the degree of intensity and ornamental effect. The lighting units should be so arranged as to provide ample intensity at street intersections.

In the usual residence streets and parkways, where foliage abounds and the border of building fronts is absent, upward lighting is of little value. The degree of illumination required depends upon the amount of travel. The decorative value of the fixtures should, as far as practicable, correspond to the character of the street. As a rule, lights must be placed low to avoid tree shadows. Hence, a fairly frequent spacing with low power lamps is required. Where foliage be absent, wider spacing and larger units are practicable and often more economical.

For outlying and newly developed sections, which are likely to develop as residence sections, it is well to provide a spacing corresponding to the residential sections, securing economy by the use of low power lamps and arranging for effective distribution, even if some glare is present. This will permit changing readily as the demand for better illumination develops.

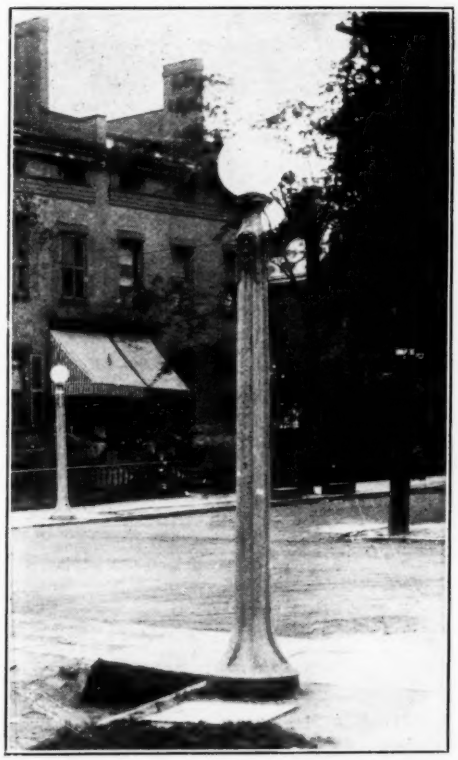
As we have already noted, the physical character of the street has a very decided bearing in determining the design of the lighting system. The width of the street should have a considerable influence in determining the height, spacing and arrangement of lighting units.

A factor which is often overlooked is the color of the street surface. A dark surface demands much more light for effective seeing than a light one. The oiling of streets, which were formerly a light colored macadam, has been a frequent source of complaint of the street lighting, tho the cause of the deficiency has often been overlooked. It can hardly be expected that streets will always be finished to suit the street lighting, but since the color has so decided an effect on the illumination, the lighting should be considered in this connection.

The variety of factors entering into the problems of street lighting render it necessary to make many compromises. The desirability of unity of design thruout a city, should not be overlooked, especially in the lighting of a long thorofare, which may extend from a business center to the outskirts. In such a case it may be necessary to sacrifice the peculiar requirements of a particular section to the production of an effective whole. It is usually practicable to grade the illumination by using lower power units of similar design, or by using wider spacing, away from the center. In case more than one light source per pole is provided, it is some times advisable to secure this result by varying the number of lights per pole.

Arrangements of Lights.—Quite a variety of arrangements of lighting units is in vogue, but the recent installations show a marked tendency toward the use of poles along the curb line, with lamps upright at the top of the pole, or hung

BALL GLOBE *pole top equipment for low-power Mazda lamp used in Rochester, N. Y., with concrete pole.*



pendent at the end of a short arm or ornamental neck. Especially in those cases where attractive appearance is considered important, the pole top unit predominates. See Figures 7, 9 and 10.

In the early installations of large units, it was the common practice to suspend the lamp over the middle of the street. This arrangement undoubtedly is generally the one which provides for the most economical distribution of light and is advantageous for producing the silhouette effect. On the other hand, this position, unless the lamps are hung very high, gives maximum glare in the eyes of a driver; while the overhead construction is rather unsightly in the day time. Long arm suspensions on curb poles are frequently advantageous, especially where foliage is present, but here again glare at night and unsightly appearance in day time, are likely to be encountered.

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¶ CLUSTER LIGHTS, *recently so popular, are wasteful of light because of ineffective distribution. Large size tungsten lamps have made simpler and more effective designs possible.*

When tungsten filament incandescent lamps were available only in small sizes, it became the practice, especially in ornamental lighting, to group four or five, and sometimes more, lamps in individual round globes at the pole top. The effect, particularly of the individual pole, was very attractive. Probably no other type of lighting units ever enjoyed as wide popularity or secured as rapid application. It was well known among engineers that, on account of the loss of light by ineffective distribution, as well as the interference of absorbing surfaces, this scheme of lighting was wasteful of light. When larger size tungsten lamps became available, with their higher efficiency and lower maintenance cost, the relative extravagance of the cluster lighting became more apparent. As a rule, the one or two light units, while individually less striking in appearance than the four cr five light cluster, make a better perspective appearance of the street, and are more efficient, so that today cluster lighting is gradually giving way to these simpler designs.

Pendent units can be made to present a neat appearance in the street, and have the advantage of usually providing a more economical distribution of light, especially in the residence districts, where the upward light can be cut off by reflectors and utilized. See two cuts on following pages.

There is considerable difference of opinion as to the relative advantages of placing poles opposite, staggering alternately from one side of the street to the other, and arranging them along one side of the street only. The opposite arrangement makes the best appearance and, on wide streets, gives fairly even lighting with proper spacing.

On narrower streets, especially with wide spacing, the staggered arrangement gives a better distribution of illumination. With very low intensity lighting, particularly on curved roadways, as in parks, the staggered arrangement should be avoided; it has some times led drivers to run off the roadway, and where dangerous obstructions occurred at the roadside, this has resulted in serious accidents.

The arrangement of poles on one side of a narrow street is often very effective and economical, and is especially applicable to the lighting of parkways, and suburban or residence streets. This arrangement is not likely, however, to meet with favor in commercial streets, as it tends to draw pedestrians to one side of the street, to the disadvantage of stores on the other side.

On boulevards and wide streets, having grass plots in the center, it is often advantageous to locate lamp poles down the center, or, in some cases, to combine this arrangement in various ways, with lines along the curbs.

In some cities small incandescent lamps have been arranged in arches or festoons, either across the street or along the curb. Very few permanent installations on this order have been made. The lighting may be quite evenly distributed over the street surface. The general effect, however, is more of a gala or festive one, more suitable for a celebration or other temporary

occasion, rather than for permanent lighting.

Height and Spacing of Lamps.—It is impracticable to give an accurate rule for determining height and spacing, but the following comments, based on the practice, should be helpful.

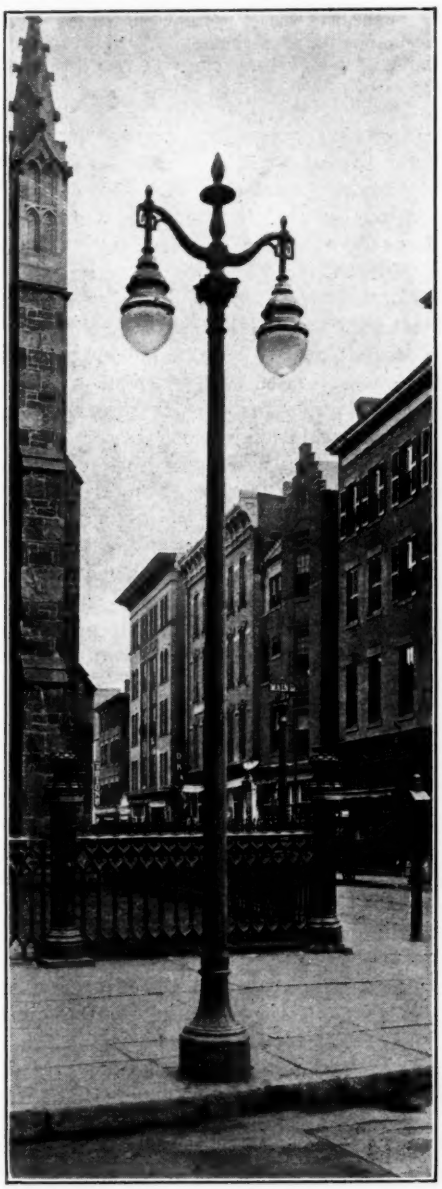
The spacing of lamps differs for various arrangements of poles, as well as for the power of unit and intensity of the illumination required. The height and spacing are interdependent and each should be determined with relation to the other, allowance being made for the characteristic distribution of light from the lamp employed.

Too frequent spacing of lamps should be avoided to prevent cluttering the street with poles. This, however, is an unusual fault, since economy usually tends to dictate too wide a spacing for the most effective lighting. In business districts, the spacing between pairs of opposite poles, or along the street between staggered poles, generally runs between 60 and 120 feet. In residence districts the spacing is a little wider, say, 100 to 200 feet. In older installations, spacing as wide as 400 feet is not uncommon; but with the range of sizes of lighting units now available, it is seldom good practice to space lamps further than indicated above, except for the so-called beacon lighting. The tendency is toward narrower spacing, using smaller power lamps, if necessary, to secure economy. Except as mentioned elsewhere with regard to ornamental street lighting, it is advantageous to provide at least one lamp at each street intersection, and the spacing should be planned with this in view. Where blocks along a street vary in length, spacing for different blocks can be slightly modified from the average, to equalize the intervals for each block.

In planning locations, it is some times found advantageous to indicate lights by means of small weights on a plan of the section to be lighted, and thus trying the different possible arrangements and spacings until the best one is obtained.

In grading the lighting for a city, comparisons can best be made in flux of light per unit of street length or area. A few years ago when lamp efficiencies were more uniform, such comparisons were often made in watts per running foot of street, but at the present time mean spherical candle power per foot, or lu-

TWO-LIGHT *ornamental pole with pendent fixtures for Mazda lamps, in use in Hartford, Conn., presents an attractive appearance and is especially suitable for the conditions. Note the distribution of the poles down the street within the view.*



mens per foot, will be more reliable. A more accurate measure, especially for high intensity lighting, would be in terms of the average foot candles of intensity on the street surface. This involves a more laborious calculation, based on particular arrangement of units and reference to photometric curves, and is not ordinarily justified.

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¶ THE NEW TESTS *are determining brightness of the illuminated surface as well as intensity of illumination, and will make it easier to fit the lamps to the kind of work to be done.*

In the very complete tests being run under the auspices of the National Electric Light Association and the Association of Edison Illuminating Companies (Report of Street Lighting Committee, N. E. L. A., 1914.), both the intensity of the illumination falling on the street and the brightness of the surface have been measured; and it is to be hoped that the data accumulated will furnish a more complete guide for the interpretation of street illumination values.

It is evident that lamps hung over the street need be higher than if located along the side. The general tendency is to place lamps too low. High power lamps and those having high intrinsic brilliancy need to be placed higher than low power lamps, or lamps with light diffusing equipment. Also, lamps which emit a larger proportion of light downward should be hung higher than those which distribute the light at wide angles.

For high power lamps, hung in the center of the street, the height in practice runs from 20 to 35 feet, or even higher. It is seldom advantageous to hang such lamps less than 25 feet above the ground.

High power pendent lamps, along the curb, are usually from 18 to 25 feet from the ground, but pole top lamps with diffusing globes are often placed as low as 14½ feet. Small units along the curb run from 10 to 16 feet.

Intensity.—Intensity is the measure of the brightness of a light source or of the illumination falling on a surface.

The intensity of a light source is measured in candle power. The candlepower of most units varies for different directions, altho for nearly all types the distribution is symmetrical with regard to the points of the compass. Some sources do not give a steady light, so that the candle power varies from instant to instant.

The candle power of a lamp is subject to depreciation with time, due to various causes, such as shrinkage of the light source, depreciation of luminous material, accumulation of deposits on the surrounding glass (products of combustion, or evaporation peculiar to the illuminant), or to dust and dirt.

Thus, we see that candle power is a very indefinite term and, unless we specify other conditions, does not represent an accurate value. In the case of incandescent electric lamps or gas mantles, it has become the practice to rate in terms of mean horizontal candle power, i. e., average candle power given in a horizontal direction, with new lamps and test conditions. Hence, this value is understood when nothing else is specified. Otherwise, it is necessary to qualify the candle power, defining it with one or more of the following qualifications: Initial candle power, average candle power thruout life or trim, maximum candle power, minimum candle power, candle power at a specified angle of elevation, mean spherical candle power, mean (lower) hemispherical candle power, mean horizontal candle power, mean candle power from 0 to 60 degrees, etc.

When we have the mean spherical candle power, or mean candle power, in any zone, we may determine the flux of light in lumens, by multiplying by the solid angle corresponding.

For example: The total lumens emitted by a light source is equal to the mean spherical candle power times 12.57.

The lumen, being a newer unit and less familiar to the laymen than the candle power, is sometimes looked upon with suspicion and disfavor. In reality it is more definite than candle power, unless the latter is elaborately explained. Since the unqualified lumen is the highest value obtainable, it is less liable to be used to

SINGLE-LIGHT *ornamental pole and pendent fixtures in use in Hartford, Conn., on the narrower business streets and to extend the lighting on principal wide streets away from the business center. Note the arc light on arm over street and the low ornamental light clusters in the background, showing that no complete design has yet been installed.*

deceive, either thru ignorance or intent.

Intensity of illumination falling on the street is measured in foot candles (in scientific circles some times called meter candles). This may refer to the intensity on the horizontal surface of the street, on a plane normal to the light rays, or a vertical plane. Measurements of either horizontal or normal foot candles, for particular points in the street, are made by means of portable or illumination photometers. Recently measurements of average brightness of street surface have also been made.

With regard to the horizontal and normal intensities, there is some difference of opinion among lighting experts as to which is the most correct measure of the value of the illumination. The horizontal foot candles measure the illumination falling on the flat surface; the normal foot candles, the brightest illumination on an ordinary obstruction. For high intensity it is common practice to use the horizontal value, while for low intensity lighting, especially with wide spacing, the tendency is toward the use of the normal.

Under the latter condition it is often very difficult to make horizontal measure-

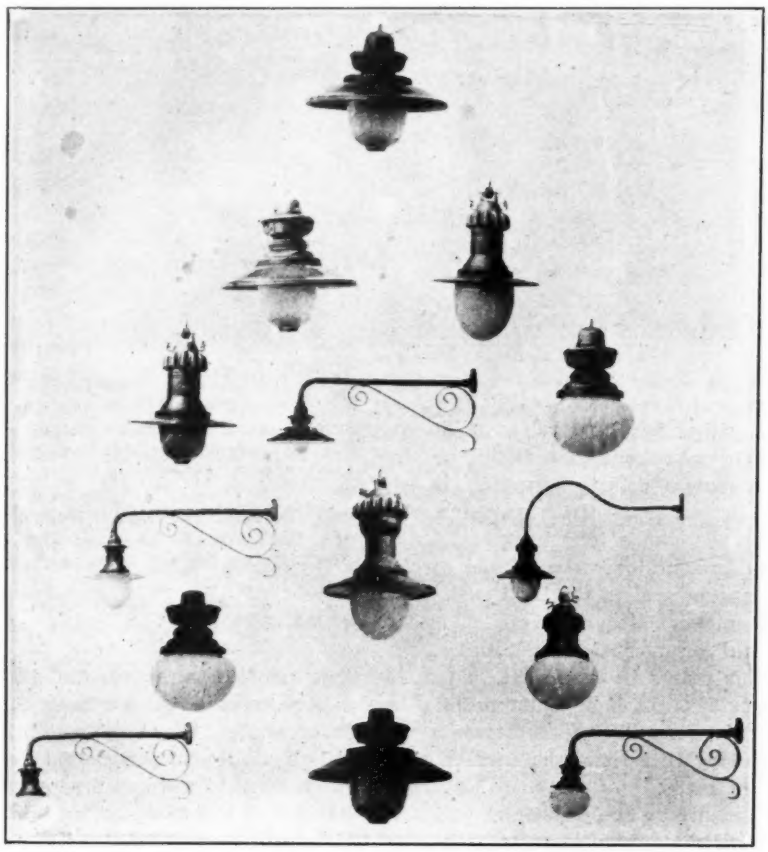
ments; moreover, it is generally conceded that the normal values give a fairer measure of the usefulness. The two values cannot, usually, be compared directly. Both values can be calculated from candle power curves, for points at a known distance from the illuminants. The calculated horizontal illumination from two or more sources may be added to give the total intensity, but normal illumination represents only the illumination from one lamp.

Since each calculation determines the intensity at one point only, it will be seen that considerable calculation would be necessary to determine the illumination thruout a representative section of street. It is common to give the values at representative points, as, along the center line, halfway between lamps, directly beneath lamps, or to plot curves showing rate of variation or lines of equal intensity.

By dividing a section of street into squares and assuming that the horizontal intensity in the center of each square represents the mean intensity of the square, it is possible to determine the average intensity on the street surface.

It is possible to figure from the above the flux of light over a section of street (foot candles times square feet, equals lumens), but it is more common to figure the illumination in terms of intensity.

GROUP OF PENDENT FIXTURES *for Mazda street-lighting lamps, showing some of the varieties of style available.*



A MODERN FRANCHISE

FOR A PUBLIC SERVICE CORPORATION

By Charles Carroll Brown, M. Am. Soc. C. E., Indianapolis, Ind.

This brief resume of a recent franchise granted by a small city shows what is easily possible in renewing an expiring franchise in securing terms more scientific in their nature than were contained in the old franchise which it replaces. Rates may be too high, but they are the best the city council could secure with their present lack of knowledge of all the facts. The future control is sufficient to bring rates to their proper level at the end of the first five-year period.

PERHAPS a better title for this paper would be "A Recent Franchise," etc., because the franchise in question is not in all respects modern. A discussion of it will be of interest mainly to show what may be obtained in the way of a new contract by a small city in a state in which there is no public service commission and no particular machinery for the control or regulation of public service corporations, when such a city wishes to renew a contract made years ago with a local organization which has since been absorbed by a great corporation owning many plants in various parts of the country.

The former franchise was one which left nearly everything in the hands of the company operating under the franchise, but fixed the rates so that they were not excessive under the former conditions. The term of the franchise was fixed and as it was about to expire the company offered new rates which were not well understood by the city authorities. They concluded that they needed expert advice and secured it. The contract includes both water and electric light service. With the advice of their experts and their suggestions of a form of contract they entered into negotiations with the company and after nearly a year of discussion they succeeded in working out a form of contract which is satisfactory to both parties. The city officials intrusted with the formation of the contract were competent business men and attorneys who were working for the best interests of the city. The resulting contract may be considered to be a fair sample, therefore, of what can be obtained by this method of negotiation, it being remembered that the experts were not called upon to pass upon the final form of the contract, their assignment having been completed when they presented their report of a form of contract which they would recommend and rates which they considered equitable for both parties. It might be mentioned that the new rates offered by the company appeared to the city officials to give a reduction in price of electric light to private consumers, but examination by the experts demonstrated that they would have resulted in a material increase in the monthly bills of users of the current. The city is held as anonymous, as discussion may be somewhat more freely made if its location is not known.

The new franchise is not modern in its first provision, since it provides that the franchise shall be sold to the highest bidder and that it shall not be sold for less than $500. This meant simply that the company should pay the city $500 for the privilege of remaining in business. The company must make this price out of its profits. The company is required to furnish, free of charge, water required to supply one public drinking fountain, one ornamental fountain, as described in the franchise, and 4,000 gallons a day for flushing sewer tanks to be operated by

the company and maintained by them on the city sewer lines, also water for flushing streets and sidewalks and building them. The company is required to pay the city 2 per cent. a year of the gross receipts of operation, the city having the right to employ expert accountants to check up the reports of the company in case they are questioned. This payment must also be made out of the consumers and the rates must be large enough to cover it. The city is entitled as a corporation to a sum which will reimburse it for its necessary expenses on account of the presence of the pipes, wires, poles, etc., on and under the streets, and the construction of extensions thereof, and this 2 per cent. allows for this and it increases in total amount as the business of the company and presumably its burden on the streets increases, so that this payment would seem to be justified if the amount of it has been properly determined.

¶ THE DETAILS OF APPARATUS *and methods of construction are given with sufficient fullness to enable the city to secure what it asks for in service and in improvement thereof from time to time.*

Definitions of terms and of notices are properly made and the company is required to keep an office open in the city during business hours. Its general duties of furnishing water and light service to city and citizens are clearly defined, and a few special details are prescribed.

The detail of methods of construction is set forth and is as full and modern as possible and still permit the continued use of the apparatus already constructed and in use, and need not be given except as to improvements provided for as shown later.

Interference with apparatus or use of the same by the city or other companies or persons already in the streets or allowed therein by the city is not permitted, and bond of the company to indemnify the city against any damage from this or any construction or maintenance operations is provided in the sum of $5,000.

The company is required to produce 100 pounds pressure on gages at plant and fire headquarters within five minutes after alarm and is carefully limited as to liability for fire loss in case this cannot be done on account of circumstances beyond its control.

¶ EXTENSIONS AND CHANGES *in existing details are provided for at expense of city or of company, as was deemed equitable by council and company.*

Permits for excavations must be procured by the company from the city and work constructed without such permits can be ordered out by the council. In case the city wishes poles relocated the company pays for the first relocation and the city pays for subsequent relocations. Provision is not made for relocation or lowering water mains with change of grade.

The city can use the company's poles for fire alarm wires, but must indemnify the company for any loss or damage on account of such use.

The provisions for extensions are numerous. The city may increase the number of public hydrants and street lights at will and the company must put them in within sixty days or city will deduct $1 a day for each day until put into use. The city must add a hydrant for each 500 feet of water main extensions it orders and if extensions are less than 500 feet long the property owners must agree to take enough water to give the company an annual revenue of 8 cents per foot of main laid, the city's hydrant being put in later when the extension is again extended to make it 500 feet long. Extensions less than 200 feet long shall be made at request of property owner, provided he bonds himself to take and pay for water supplied him for at least five years. They must be made if more than 200 feet long if the property owner pays the whole cost of the extension, but he will not be required to pay any water rent until his bills for water furnished equal this cost, after which time he pays rental as other consumers. Connections to properties on lines of mains shall be made on request,

payment of $5 for making the connection complete to the curb or grass plot in front of property, and making contract for water at price not less than $5 a year. Extensions for electric service less than 350 feet long shall be made on request, and if more than 350 feet long on payment of the cost of the excess over 350 feet. Thirty, sixty and ninety days' time are allowed the company for the work of making house connections, short and long extensions respectively.

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¶ RULES, *regulations, kind of service, are provided for, and penalties for violations or failures by company, city and private consumers are imposed*

The company can make necessary rules and regulations, subject to approval of council, and council will pass ordinances approving them, preventing pollution of water and injuries to property. Rules, regulations and rates must be applied to all consumers without discrimination. Violations of rules or non-payment of bills subject consumer to shut off, and such delinquent consumer must pay 50 cents in addition to the bill before service will be turned on. This provision does not state definitely what will happen in case the consumer moves away leaving an unpaid bill, or the property changes hands and the seller leaves an unpaid bill. Failure to furnish service for thirty days subjects the company to forfeiture of franchise, and for less time to forfeiture of double the rates for city service for the time the failure extends. Private consumers on meter rates pay actual service and minimum rate does not apply in such case. Deductions are made for single hydrants or lights out of service at double the contract rates if out of service more than three days, or at schedule rates for less time. Service is defined for hydrants as in good working order and constantly supplied with water; and for street lights as burning from one-half hour after sunset until one hour before sunrise. The question of whether failure to supply the service is unavoidable or the fault of the company may be referred to the board of arbitration provided later, in case of disagreement. Responsibility for reporting hydrants and lights out of order is put on the chief of police.

The city's bills for service rendered are paid in city warrants due six months from date, with 6 per cent. interest, and may be paid at any time before they are due.

Complaints as to justice of action of the company regarding granting or refusing service can be referred to the council, whose action is final.

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¶ RATES *for city service and for private consumers for water and light are given in full and are in general conformity with rates in other small cities under similar conditions.*

Rates for city service are as follows: Hydrants, $42.50 for each of first 65, and $40.00 for each additional; water for city purposes, except the free water above noted, 10 cents per 1,000 gallons; hydrants to be maintained by company and used by city for fire purposes and for flushing streets and mains and for building and repairing streets; damage to hydrants by fault or negligence of city employes to be paid for by city. For street lights, $70.00 each for first 46 6.6 amp. enclosed A. C. 500-watt lamps, and $60.00 for additional; $19.00 for 40-c.p. tungstens, $24.00 for 60-c.p., $32.00 for 80-c.p. $40.00 for 100-c.p., lamps to be maintained by company; light in city buildings at 3 cents per kw.hr., including school buildings, meters and connections furnished by company.

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¶ NEW AND MODERN STREET LAMPS *are provided for, also a meter for determining amount of current used, tho lamps are paid for at flat rates.*

New street lamps are to be 500-watt or more A. C. enclosed arcs, incandescent tungstens or their equal. City locates lamps and may change from arc to tungsten or the reverse without charge. Changes in location of old lamps made within ninety days of making of contract are without charge, but those made later

are at charge of city. When changes of types of lamps are made the city may raise the question of rates for new lamps and if parties cannot agree, the question may be referred to the arbitration board later provided for.

When the city requires, a specified ammeter will be installed to measure the current used in street lighting, to be paid for and operated at equal cost of city and company.

Water rates for private consumers for quantities used per month named are as follows: 1,000 to 20,000 gallons, 30 cents per 1,000; 20,000 to 40,000, 25 cents; 40,000 to 60,000, 20 cents; 60,000 to 80,000, 15 cents; 80,000 to 100,000, 10 cents; over 100,000 gallons, special; with a minimum of 50 cents a month from October 1 to March 1, and $1.50 from April 1 to September 30. Meters must be installed on all service within nine months, provided that not more than twenty-five meter installations per month can be demanded. All meters must be kept in good, accurate running order. Flat rates are provided to be used until the meters are installed, the number of flat rate consumers being reduced rapidly. Discount of 10 per cent. is made from bills if paid before 10th of month, but bill cannot be made less than the minimum above.

¶ AN ARBITRATION BOARD *for fixing rates and settling other possible contests over certain provisions is provided for in case city and company cannot agree at end of five-year period or other date of proposed changes.*

Electric power and heating rates to private consumers are subject to special contract; lighting rates are as follows: 0 to 30 kw.hr. (presumably used per month), 12 cents per kw.hr.; 30 to 60, 10 cents; 60 to 150, 7 cents; 150 to 200, 6 cents; 300 to 1,000, 5½ cents; over 1,000 kw.hr., special; subject to 10 per cent. discount if paid before 10th of month. Meters must be furnished and kept up by the company and tested free of charge at request of customer.

The rates for public and private service quoted above are fixed as the maximum for five years, and are then subject to change by agreement.

If the city and company cannot agree upon the new rates a method of arbitration is provided, which has already been in successful use in another small city under similar conditions. It is as follows: "At no time during the term of said franchise shall the maximum rates to be charged said city or its inhabitants for water or electric current be higher than the maximum rates herein fixed. If the city and the grantee shall be unable to agree upon the revision of rates herein provided for, such rates shall be fixed for said five year period, in the first instance by any state body created by law for such purpose; or, in the absence of such state board, such rates shall be fixed for said period by a board of arbitration of three wholly disinterested and competent engineers, none of whom shall be employed by or connected with the grantee or the city, to be organized as follows: One member shall be selected by the city and one member by the grantee, and these two members so selected shall select the third member. In the event the city or the grantee shall fail or refuse to select a member of said board of arbitration, or the two members of said board selected by the city and the grantee shall fail to select the third member of said board, either said city or said grantee may apply to the judge of the circuit court, asking said judge to select a member of said board to fill such vacancy therein, and the member of said board selected by said judge shall have full power to act with the other members thereof." Some details of procedure are included. One significant addition to the above provision, which has been worked out by the company, reads: "On all questions, except as to rates, such board of arbitration shall be three disinterested, competent persons." In the light of some experience of the writer in securing a disinterested, competent board under a provision similar to the above, except as to the last sentence quoted, this sentence indicates the intention of the company to have its member of the board an advocate of its side of the case.

In proceeding for determining rates the

board is not to take into consideration any value of the franchise, except so far as the 2 per cent. of gross expenses, which is paid to the city, may be so considered.

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¶ CONSTRUCTION OF A WATER FILTER *under approval of city and of State Board of Health is prescribed.*

A special provision in this franchise gives the company a year to begin the construction of a filter for the water supply and six months more in which to complete it and put it in operation. Due penalties for failure to perform these duties are provided, also for failure to operate the filter satisfactorily. Plans and specifications for the filter plant must be approved by the city and by the state board of health. If the company fails to supply water satisfactory to the state board of health for any five days, after the filter is in full operation, the company must pay a fine of $5.00 a day for up to ten days; $10 a day up to fifteen days; $20 a day up to thirty days, when the franchise will be forfeited unless the failure is due to circumstances beyond the company's control, in the opinion of a board of arbitration appointed as above. In case the board decides in favor of the company, it shall still pay the $20 a day fine for such time as the quality of water is below the state board of health standard, and such other damage as the city may prove itself to have sustained on account of such impure water, or that its inhabitants have sustained. At any time the city is dissatisfied with its water supply as to quality, it can call in the state board of health and if that board so decides, the company must bring its water supply up to standard within thirty days or forfeit its franchise, unless the failure is not on account of its own negligence, such question to be decided by the board of arbitration. The state board of health must approve of any new system or source of water supply. These provisions leave the company free to take water from any source it desires, provided it can bring such water up to the requirements of the state board of health, and at the same time enables the city to enforce the supply of a sanitary, safe and palatable supply. The application of these provisions is suspended for the eighteen months until the filter plant is in operation.

The rates may be considered rather high, but it must be remembered that they can not be raised during the term of the franchise, but may be lowered at any five year period. It should also be noted that the city has at the present time no information as to the operations of the company, but, by the terms of this contract will have considerable information, as well as the aid of the board of arbitration, at the ends of the five year periods, tho the board will not have as much opportunity to secure the necessary knowledge in detail as it should, since the company has prevented the insertion of a clause giving the board of arbitration the right to examine the books of the company, and the city has not reserved any such right, except as to the gross proceeds of operation.

The writer will not attempt at this time any extended comment on the provisions of this franchise. They speak for themselves. He will only call attention to the safeguarding of the quality of service, both water and electricity; the revision of rates at the option of either party at intervals not too great and by an expert board; the control of sanitation by the state board of health. With the exception of one or two details concerning which the company has not agreed with the consulting engineers of the city, it is believed that these controls are as safe as they can be in a state without a well-established, competent public service commission. Rates may be too high to begin with, but they are subject to reduction at the end of five years. It should be remembered, also, that some of the controls assumed cost money, and that the company must make a material addition to its plant to provide the better water supply demanded. It is also a fact that the city was not objecting to the rates in force, but its demands were almost entirely for pure water and plenty of it, and for modernizing to some extent the street lighting.

TREATED WOOD BLOCK PAVEMENTS

THEIR HISTORY IN THE UNITED STATES

The history of treated wood block pavements in the United States covers a period of nearly twenty years, really beginning with an experience in Indianapolis with a modern untreated block pavement, laid with wood, slow to decay, but too soft for heavy traffic. It shows a rapid development in the use of this form of pavement, due to the excellent qualities it exhibits, and shows the many changes made in details of treatment and of construction which experience has brought about. This outline is from a report of a committee of the American Wood Preservers' Association.

THE first use of untreated wood blocks as a paving material in the United States is said to have been in a pavement laid in New York City about 1835. Before 1840 Boston and Philadelphia laid pavements of spruce and hemlock blocks, which cost from $2.00 to $2.50 per square yard. The use of untreated wood blocks for pavements was soon taken up by other cities and a large variety of species were employed, such as tamarack, Douglas fir, and redwood. Large amounts of round blocks, mostly cedar, were also used, especially thruout the Middle West.

In the early use of wood blocks considerable attention was given to the form of the blocks and a number of these were patented. The Nicholson block, patented in 1848, was extensively used between 1860 and 1870. These blocks were rectangular in shape and gave a much more even surface than many of the other forms used.

During the sixty years preceding the use of treated wood blocks many cities laid large quantities of wood pavements at great expense. These were satisfactory at first, but they soon decayed, and in a comparatively short time after laying they had to be removed. Subsequent to 1871 over 1,000,000 square yards of untreated wood block pavement were laid in the city of Washington, D. C., costing from $2 to $4.20 per square yard. Nearly 30 per cent. of this was removed six or seven years after it was laid, and by 1889 the last of the blocks had been removed. Similar trouble was experienced by other cities using untreated wood as a paving material.

In most of the early wood block pavements little care was taken in the selection of the wood used, or in protecting it from decay. Often the blocks were laid on a plank foundation, placed directly on the ground, or upon a sand base, thereby creating a favorable condition for decay.

While both wear and decay are the principal causes of the failure of wood block pavements, decay is by far the most destructive agency. After years of repeated failures attention was directed to the use of wood preservatives.

In 1882 to 1885, wood blocks treated by the Wellhouse process were laid in St. Louis on Pine and Oliver streets, and are said to have remained there until worn out by traffic. The blocks were treated by the St. Louis Wood Preserving Company and were guaranteed by the contractor for nine years.

One of the first treated wood block pavements was laid in Galveston, Texas, about 1874. A pavement of about 75,000 square yards of longleaf pine blocks was

laid at this time and was in service until 1903, when it was removed. It is not thought that these blocks were given the same kind of treatment that is usually given at the present time. They were laid on a sand foundation, no concrete being used. Details of the treatment of these blocks are lacking.

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¶ THE FIRST EXTENSIVE USE *of modern creosoted wood block for pavements was begun in Indianapolis, which city still has some of the early streets in use after nearly twenty years.*

In 1896 Indianapolis laid a few streets with blocks of Washington red cedar. These blocks were thoroly dried and then placed for six hours in a bath of creosote, which was heated to a temperature of over 210 degrees F. The absorption was estimated to be about 3 pounds per cubic foot. No expansion joints were used and considerable trouble was experienced on account of swelling. These blocks are still in use and are said to be in a good state of preservation.

It was realized that the best results could not be obtained by dipping the blocks, and in 1898 the first pavement was laid in Indianapolis of blocks treated with creosote under pressure. Longleaf pine was used and was given a treatment of from 10 to 12 pounds per cubic foot. At this time no particular attention was given to the character of the oil. This pavement, altho now reported to be in bad condition, gave such good results that city engineers began to appreciate the possibilities of treated wood blocks.

The first wood block pavement used in the East was laid on Tremont street, Boston, in 1900. The blocks were treated by the creo-resinate process, in which a mixture composed of one-half creosote oil and one-half resin was used. The object of adding the resin was to render the blocks more resistant to the absorption of water and to assist in retaining the creosote oil in the wood. This pavement is still in good condition. A sample pavement of this kind was also laid on State street, Brooklyn, N. Y., in 1902.

In 1899 one of the two roadways on the Rush street bridge in Chicago was paved with creosoted longleaf yellow pine blocks and the other roadway with untreated blocks. This afforded a good test of wood pavement, as the traffic on this bridge was probably heavier than on any other street in Chicago. It was necessary to remove the untreated wood blocks at the end of three years, whereas the creosoted section was in good condition at the end of seven years and gave indications of good service for several years more. They were then taken up on account of the untreated plank foundation being decayed.

One of the first creosoted wood pavements in Chicago was a section of longleaf pine blocks laid in front of the Auditorium hotel in 1900.

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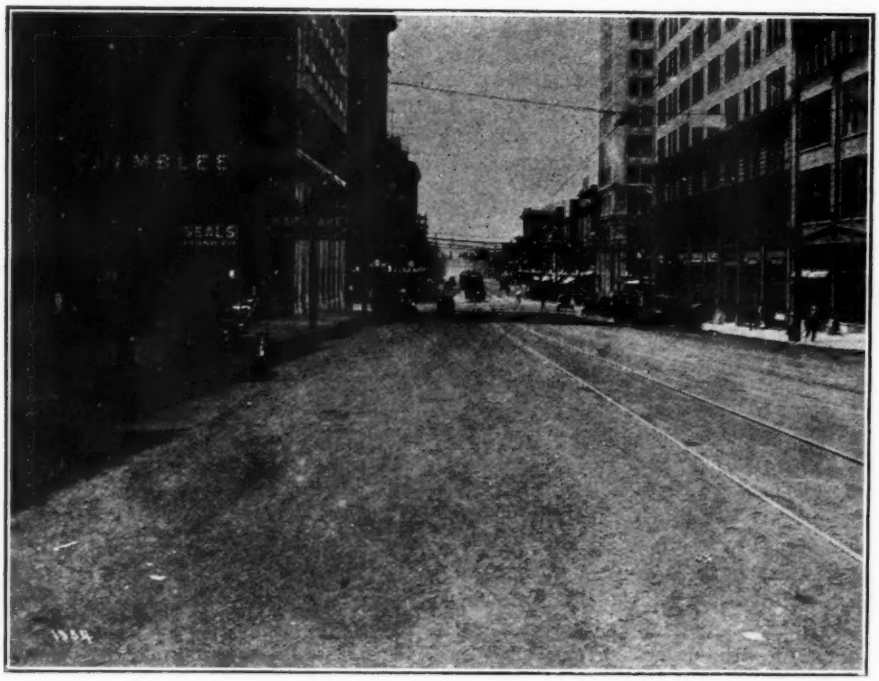
¶ THE LARGER CITIES *soon recognized the value of wood blocks for pavements and are using large quantities.*

The excellent satisfaction given by these treated pavements, which were largely experimental, resulted in a very rapid increase in the use of wood blocks thruout the country. The larger cities in particular recognized the merits of wood blocks for streets subjected to heavy traffic, as well as for residence streets. Wood pavements in Boston, New York, Chicago and other cities were installed under severe traffic conditions, where the relative durability could be compared with pavements of other materials on the same street. Many of the other types of pavements which were under similar traffic conditions failed, while wood block remained in good condition. The durability, noiselessness and other desirable features of treated wood blocks have been realized more particularly within the last five or six years.

At presently nearly thirty miles of the most heavily traveled streets in Manhattan Boro, New York, are paved with treated wood blocks. In 1912 New York laid about 225,000 square yards and over 180,000 square yards in 1913. Chicago had over 600,000 square yards in 1912 and laid over 165,000 square yards more in 1913.



CREOSOTED WOOD BLOCK *pavement on First avenue, Birmingham, Ala.*

Minneapolis was one of the pioneer cities in the use of treated wood pavements, and has probably laid as much as any city in the country. The city already has over 1,000,000 square yards and expects to add about 175,000 square yards in 1914. By January 1, 1914, Detroit had over 458,000 square yards of treated wood pavement, having laid over 166,000 square yards of this in 1913. A number of other cities are also laying large amounts of wood block pavement each year.

Species of Wood.—Southern longleaf yellow pine was most used in the earlier treated wood pavements. This wood has been found by experience to give excellent satisfaction and is most largely used at the present time. Other species that have been used are tamarack, Douglas fir, hemlock, Norway pine, maple and black gum.

The species most generally admitted by various specifications comprise longleaf yellow pine, Norway pine and tamarack. Black gum has been used to some extent in the East, but it is claimed that this species has not been entirely satisfactory. Douglas fir is used to a considerable extent in the far West.

Tamarack has been used in several cities and has given good satisfaction. In order to obtain more complete knowledge on the relative value of the various species of wood for paving purposes, the United States Forest Service laid an experimental pavement in co-operation with the city of Minneapolis in 1906. The woods used in the experiment were creosoted longleaf pine, tamarack, Norway pine, western larch, white birch and hemlock. Longleaf pine was used as a basis of comparison for the other species. The last inspection was made July 15, 1914, eight years after the pavement was laid. From the results of this inspection the species may be classified in the order of their efficiency in this pavement in the following order:

1. Longleaf pine.
2. White birch.
3. Eastern hemlock, tamarack.
4. Norway pine.
5. Western larch.

Undoubtedly, there are a number of

species of wood that would make satisfactory paving material, but on account of the incomplete knowledge of their value city engineers prefer a wood that has been tried and proved satisfactory. It seems probable that other species will in time be used more extensively than at present. The proper selection of the species of wood used for paving purposes is most important as it determines, to a large extent, the wearing qualities of the pavement.

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¶ DIMENSIONS OF BLOCKS *have varied from time to time and now vary according to use, economy and personal preferences of engineers.*

Depth of Blocks.—Recently there has been a tendency to reduce the depths of the blocks and at the present time 3½-inch blocks are frequently specified, and even 3-inch blocks.

New York City has adopted a 4½-inch deep block as standard in Manhattan, where it has been demonstrated that a 3½-inch block is not strong enough to withstand the heavy traffic. The Boro of Richmond (Staten Island) uses 3-inch block as standard. The Boro of Queens has some of the best wood-block pavement in this country and after nearly ten years' service 3-inch deep blocks show practically no wear. The traffic is plentiful, but the vehicles not very heavy.

The blocks used in the early pavements were generally 4 inches wide. In more recent practice the width has often been reduced to 3 inches. This prevents the blocks being laid on their sides. The permissible length varies from 5 or 6 inches to 10 inches.

Specifications generally require that the blocks shall be sound, free from large or loose knots, shakes and other defects of that nature. There are differences in the number of rings per inch specified and in the amount of sapwood that is permissible. Some engineers allow the use of blocks having five or six rings per inch and others specify not less than eight or nine.

The amount of sapwood allowed usually varies from 10 to 40 per cent. In the early use of treated wood blocks, specifications were more rigid in the requirement of a larger percentage of heartwood. Experience seems to indicate, however, that treated blocks having both sapwood and heartwood show no noticeable differences in wearing qualities from those without sapwood.

Preservatives.—The earlier wood paving blocks were treated with a light grade of creosote oil. Later, due largely to expansion difficulties, varying amounts of tar were added. The bleeding trouble has recently led some cities, notably Chicago, to specify a very high-boiling creosote free from tar. This oil has the disadvantage of being high in cost.

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¶ HEAVY OIL *for treating blocks is popular at the present time under carefully drawn specifications as to quality of oil and treatment.*

Most of the cities in the United States are now using an oil having a specific gravity of 1.10 to 1.14, and containing a large proportion of tar, usually required to be nearly free from carbon. Such an oil is also permitted in the specifications for paving oils of the representative societies interested in this subject.

There is little difference of opinion as to whether oil from water-gas tar should be used. It is claimed that this cheaper product might be mixed with coal-tar oils without lessening the value of the pavement. Several experimental pavements have been laid using this product, and until the results of these experiments become available most engineers prefer to exclude water-gas creosote from their specifications.

Method of Treatment.—The earlier pavements were treated usually with from 10 to 12 pounds per cubic foot of oil. Engineers then went to the opposite extreme, until it was the general practice to inject 20, and in some cases even 24 pounds per cubic foot, resulting in a greatly increased cost and excessive bleeding of the oil. Recently the tendency has been to reduce absorption, and at present 16 pounds per cubic foot is about the average used.

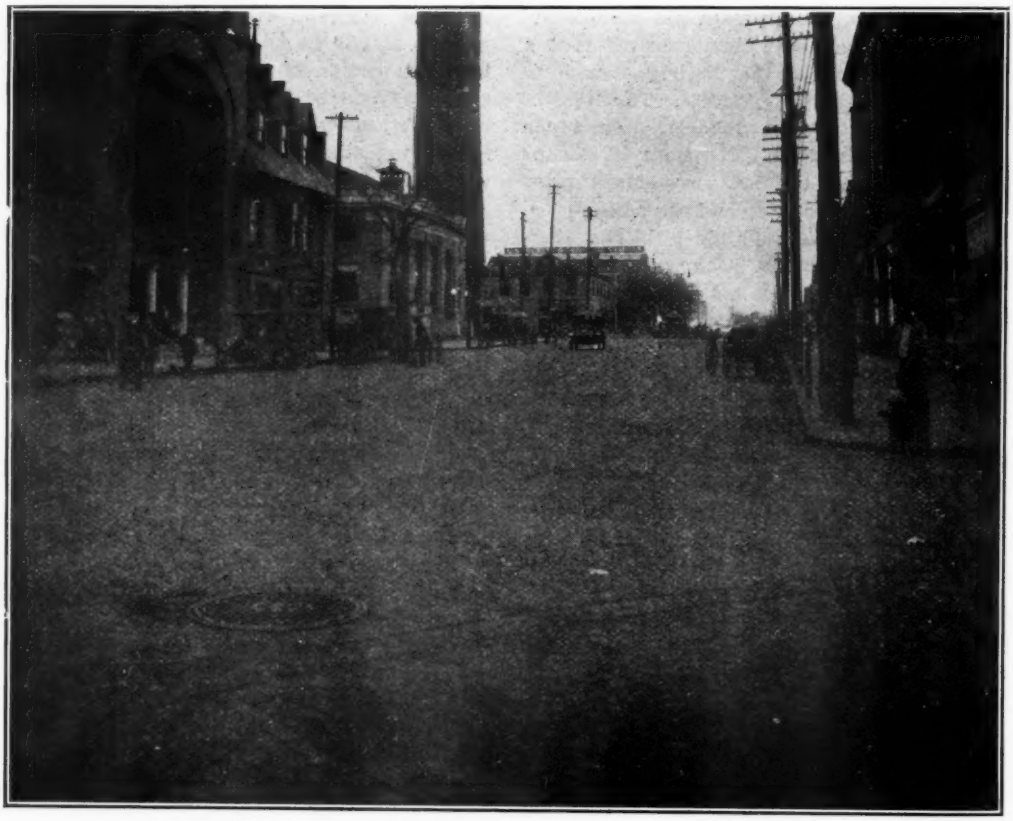
The method of treatment first used was, in general, to subject the blocks to a dry heat of 250-280 degrees F., or to steam them at pressures varying from 25 to 50 pounds per square inch for periods varying from 3 to 4 hours, or more, depending upon the condition of the wood. A vacuum of 24 to 26 inches was then drawn to remove the moisture, after which the preservative was admitted without breaking the vacuum, and pressure applied until the desired absorption was obtained.

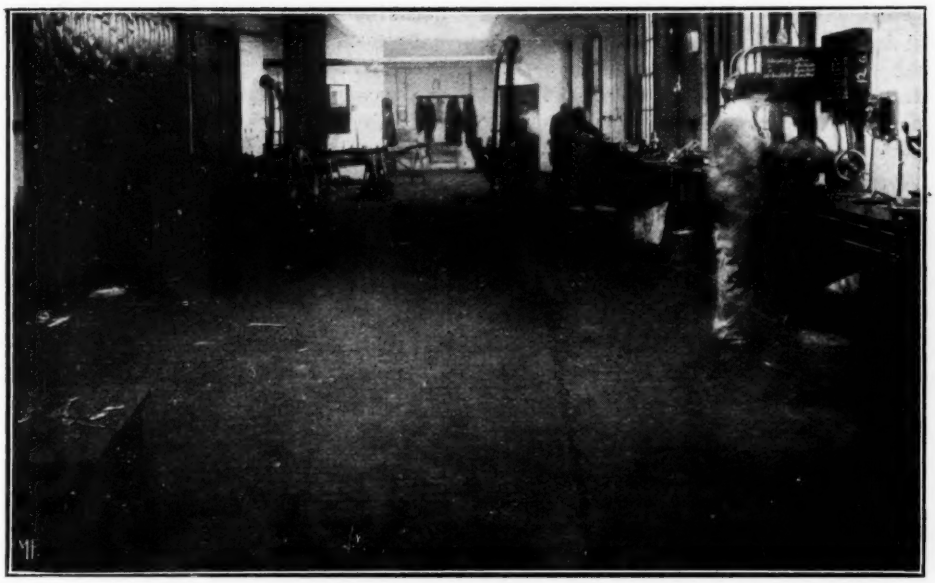
At present the method of treating the blocks is often left to the treating plant operators, the specifications merely requiring a given absorption. Some cities, however, outline the method of treatment in detail as to preliminary steaming, vacuum and pressure periods, giving the time, temperature, pressure, etc., for each operation.

Methods of Laying.—The old type of untreated block was generally laid either on a sand or a plank foundation, neither of which was satisfactory. Treated blocks were usually laid on a concrete foundation covered with a sand cushion, a method of laying which is still in quite general use. Much trouble has been experienced from the sand shifting or being washed from under the blocks, and thus producing an uneven surface in the pavement. Expansion troubles were also caused by water penetrating the spaces between the blocks and saturating the sand. A bituminous coating is now sometimes laid directly on the concrete base instead of the sand cushion.

While the sand cushion is still quite generally employed, there is a well marked tendency toward the use of a sand and cement mortar. This usually

CREOSOTED WOOD BLOCK *pavement in Americus, Ga.*





SHOP FLOOR *paved with creosoted wood blocks.*

consists of a mixture of one part cement to three or four parts of sand and is spread from ½ to 1 inch thick. This results in a more satisfactory pavement, especially under heavy traffic.

The foundation now generally adopted consists of a concrete base from 5 to 7 inches deep, depending upon traffic conditions, the mixtures commonly used being 1, 3, 5 or 1, 3, 6.

Joints.—In some of the early pavements laid no expansion joints were used, and in many cases no trouble has been experienced on account of swelling. In many other cases, however, much trouble has been caused through failure to properly provide for swelling of the blocks.

Streets on which the traffic is heavy do not require as much provision for expansion as do streets of medium or light traffic. In the Brooklyn and Manhattan pavements no provision is made for expansion. For a street 30 to 40 feet wide the expansion joints are usually ¾ to 1 inch wide and filled with bituminous filler. In most cities no joints are employed to take care of expansion lengthwise with the street.

The angle of courses is a point upon which engineers are not agreed. The most common method of laying has been at 90 degrees with the curb, but many of the streets are now paved with the courses at oblique angle. In the Minneapolis experimental pavement the blocks laid at oblique angle did not wear as fast as those laid at 90 degrees, since traffic was not directly across the joints of the pavement. Another advantage of the oblique angle of laying is that longitudinal expansion joints at the curb will take care of expansion in both transverse and longitudinal directions.

Filler and Top Dressing.—A bituminous or pitch filler was commonly used in the early treated wood block pavements. Bituminous or asphaltic fillers and also sand and cement fillers are the materials generally used at the present time for filling the joints. The advocates of the sand filler maintain that the sand fills the joints completely and that the surface of the pavement becomes practically homogeneous. It is claimed that a waterproof joint is formed by the sand absorbing the oil which exudes from the blocks. Others argue that the sand packs into the joints, thereby making an unyielding filler which does not allow expansion, but permits water to enter between the blocks, causing expansion of the pavement.

Advocates of the cement grout filler claim that the use of this material insures the joints being completely filled and waterproof. The mixture is usually made of one part cement and one or two parts sand, which, after mixing to the proper consistency, is swept into the joints.

Opponents of the cement grout filler claim that unless the pavement is kept free from traffic for a sufficient time to allow the grout to set thoroly the bond of the mortar will be broken. Even when the mortar is thoroly set it is claimed that its strength is not sufficient for traffic conditions, and the filler, therefore, serves the purpose no better than sand, while at the same time it is more expensive.

Those favoring the bituminous filler argue that the joints filled with a tar or asphaltic preparation constitute individual expansion joints between each block, thereby allowing for expansion thruout the pavement. Moreover, it is claimed that the pavement is made waterproof and that no moisture can enter between or under the blocks.

On the other hand, advocates of the other fillers argue that a bituminous material becomes soft and sticky from the oils that exude from the blocks and may add to the bleeding trouble. In practice, the bituminous fillers are most largely used and are giving the best satisfaction.

The top dressing most commonly employed is a layer of sand spread about one-half inch deep over the completed pavement. This sand fills up any small pockets that may be present and is more or less ground into the wood, making the pavement less slippery.

CANAL DE MANGUE

Rio de Janeiro, Brazil.

The sanitary condition of the East End, a portion of Rio de Janeiro, the capital of Brazil, rather low and swampy, has been greatly improved by the construction of a broad, beautiful canal which, besides being so picturesque, serves the useful purpose for which it primarily was constructed, that of draining the marshy ground and acting as a main outlet for the rain water that frequently comes down in torrents from the surrounding hills.

Rio is the home of the stately Royal Palm, for they are in evidence everywhere thruout the city. The Mangue Canal runs thru the center of the Avenida de Mangue, and there are four driveways along it, two on either side of the canal, as the Avenida is very broad. The accompanying photograph shows the canal and gives some idea of the bordering driveways.

February, 1915.

WATER WORKS PLANT

OF RIVER FOREST, ILLINOIS.

By Karl M. Mitchell, General Superintendent.

This interesting account of the development of the water works system of a small city is prepared by an official who corresponds to the city manager, now becoming so popular. He conducts a department of municipal news in the local weekly paper, and the data in this article were collected for use from time to time in that department.

PROBABLY the most important and pressing problem of the village government today is that of its waterworks. The consumption is rapidly increasing, while the water level in the wells is rapidly receding.

Until May 23, 1893, River Forest was dependent upon shallow wells for its water supply. In that year, having attained a population of 500 to 600, and under the influence of the progressive spirit dominating the world's fair period, culminated a movement begun some time previously for the construction of a works and distributing system.

A deep well 1,000 feet in depth was bored, a steam generating plant, deep well pump and a service pump were installed, a reservoir and a standpipe constructed, and several miles of mains laid covering most of the village south of Chicago avenue and west of Lathrop. Even a public fountain was not overlooked, and was installed at Park and Lake, where it was maintained for many years, since replaced by one of the modern bubbly type.

The maximum output of the works at that time, with a population of 600, was 150 gallons per minute. The population has since been multiplied by six, and the output less than doubled.

A few years later the deep well pump was replaced by an air-lift system. In 1904 a second well was driven, also being operated by the air-lift system. This was the last change made that increased the output of the plant.

In 1911 steam was displaced by electricity as a motive power. In 1913 reservoir No. 2 was constructed, to increase the storage capacity for fire and emergencies.

During the entire period that the water works has been in operation, Ernest Micklish has been in charge. There has been no serious mishap. One large leak in Lake street, a few years ago, was occasioned by electrolysis. The Concordia fire last February was the only fire that has taxed the capacity of the plant. While the plant is not efficient, judged by present-day designs and methods, the machinery as installed has been well maintained and extensive repairs have never been found necessary.

The steam plant was not removed at the time the electric plant was installed. Most of it is in good condition and serviceable. It should be sold. The air compressor and pumps particularly are in good condition.

During 1913 there was a marked increase in water consumption, caused by the connection to the water system of the stores in the bank building, the dairy, the college, all of which were large users, and a number of private residences. At the same time there occurred a marked drop in the water level in the wells, and a corresponding increase in the distance the water was lifted. As the capacity of the plant remained constant it followed that the quantity of water raised per hour was diminished.

The water department faced a double emergency. The output of the plant,

which had been scarcely equal to the maximum demand in the summer of 1913, had decreased, while the consumption had increased.

A series of tests was conducted during the winter of 1913 to ascertain the operating conditions, to indicate the most feasible method by which the anticipated shortage in 1914 could be avoided, and to determine if possible means for increasing the operating efficiency.

The tests indicated that the plant was operating at an over-all efficiency from wells to reservoir of 14.2 per cent. The component parts of the plant were then tested and results analyzed to determine where the greatest losses occurred, and what changes could best be made to increase both the output and efficiency.

These tests resulted as follows:

Equipment (wells to reservoir)	Individual Efficiency Per Cent.	Input H. P.	Output H. P.	Energy Consumed H. P.
Motor	92	46.9	43.14	3.76
Belt	95	43.14	41	2.14
Air compressor	63	41	26	15
Wells	25.7	26	6.7	19.3
Total	14.2	46.9	6.7	40.2

The efficiency of the motor and belt was reasonably satisfactory, while that of the compressor could be materially improved only by the installation of a new compressor. The lowest efficiency and greatest consumption of power was found to be in the wells.

It may here be explained that our works are operated on the air-lift system. Compressed air is conveyed down the well a considerable distance below the water line and released within an upright discharge pipe. The air rises rapidly in the discharge pipe, forming with the water an emulsion lighter than the water, the buoyancy of which, together with the pressure of the water from beneath in the submerged discharge pipe, cause it to rise and flow out of the top of the pipe.

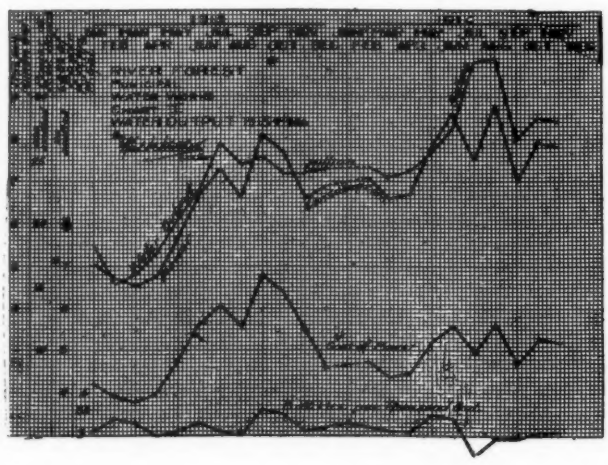
Its action is similar to that of the familiar coffee percolator, in which the expansive force, instead of compressed air, is steam generated at the bottom of the pot directly under a flaring hood or bell, which opens into a vertical tube. The steam collects under this hood until its expansive force drives it upward thru the tube to escape at the top, carrying with it a quantity of water which overflows.

The efficiency of an air lift depends upon the length of air and discharge pipes in the well, their size, the friction loss in the air line, the air pressure used and available, and the friction loss in the discharge line.

To secure the maximum efficiency from our air lift system will require the repiping of the wells so as to reduce the air and water friction losses, permit of a larger ratio of submergence, and a higher operating pressure.

Other important phases of the situation are also to be considered. The friction loss in a 6 or 8-inch well, such as ours, is greater than in 16 and 18-inch wells, such as operated by some of the neighboring suburbs. When pumped at a given rate the lift is less, i. e., the water level high-

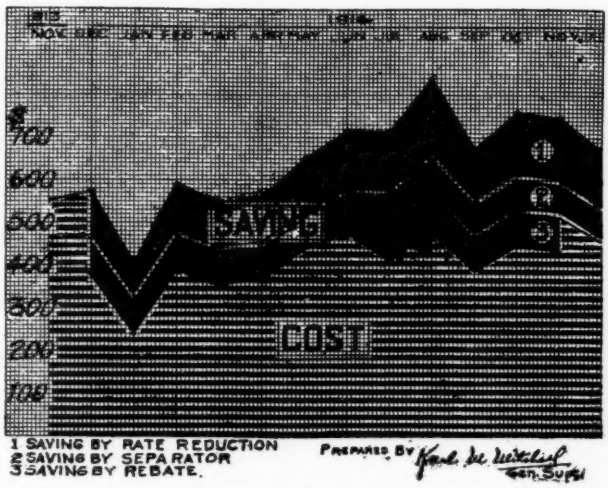
RIVER FOREST WATER WORKS. *Output of water, consumption and cost of power and rate of use of electricity.*



er, in a large well than in a small well.

The fact that the water level thruout this section is receding quite rapidly is of grave significance and suggests the possibility of the lift becoming so great, and consequently the power cost, that we may be obliged to secure Lake Michigan water.

The immediate problem last spring, however, was to provide sufficient water for the period of maximum demand in 1914, and to increase the efficiency if practical.



RIVER FOREST WATER WORKS. *Saving in cost of power by reduction in rate for electric current, by installation of air separator, and by rebate on bill for electricity.*

The most effective method to accomplish these purposes was determined to be the installation of a separator at the top of each well. Under the system then in operation the discharge pipe rising vertically from the well changed its direction and ran horizontally to the reservoir. As the operation of an air lift depends upon the buoyancy of the air, to be effective it must operate only in a vertical direction. When operated horizontally it becomes inefficient. A separator is simply a tank at the top of the vertical discharge pipe, which receives the water discharged, permits the air to escape, and which is elevated sufficiently to permit the water to flow into the reservoirs by gravity.

During the last of June a separator was installed on each well. Slight adjustment was also made in the length of air pipe in the wells, but within limits that could be operated by the present compressor.

The important thing accomplished by the installation of the separators was the increase in water output sufficient to avoid the threatened water famine and meet the unusually heavy demand of the summer.

In the table below is given the output of the water works in thousand gallons, by months, for 1914, with the increase in 1914, showing that the use of water in the earlier part of the year was much greater but not so much in the later months:

Month	1913	1914	Increase Thousand Gallons	Per Cent. Increase
January	5472	*4916	....	..
February	4616	7358	2742	59
March	4797	7102	2305	48
April	5280	7260	1980	37
May	6073	7717	1644	27
June	6819	8325	1506	22
July	7913	9772	1859	23
August	7380	9937	2557	34
September	7603	7980	377	5
October	7179	8535	1359	19
November	7160	8392	1232	17
December	7264	7710	446	6

*20 days only.

These figures are shown graphically on chart I. There is also shown the power consumption in kw. hours; the cost of power, not deducting the rebate, and the power consumption per thousand gallons pumped.

The large increase in water consumption in 1914 is due to the increase of 15 per cent. in the number of connected services, some of which, as the stores in the bank building, the college and dairy, were large consumers, and to a dry season.

It will be noted that the consumption rose from around 5,000,000 gallons in the first months of 1913 to between 7,000,000

and 8,000,000 gallons in July, 1913, and that, instead of the normal drop that may usually be expected during the winter, the consumption was maintained at this figure thruout the fall and winter of 1913 and spring of 1914, until June, 1914, when it started upward again. In August the consumption was nearly 10,000,000 gallons, more than double that of February or March, 1913, and 11 per cent. in excess of the maximum output of the water works operating twenty-four hours a day for thirty-one days at any time before the separator was installed.

From the middle of May to the middle of June, tho we were operating twenty-four hours per day much of the time, our demand was in excess of our output, and we were obliged to purchase 680,000 gallons from Forest Park. The situation was critical. The shortage of water was real.

This condition had been anticipated, however, and, as a result of the investigations made during the winter, the installation of separators was authorized in June, and before the end of the month they were in operation and the famine averted.

Their installation increased the output of the wells 28 per cent., from 202 gallons per minute to 259 gallons per minute. This was for normal operating.

A test was made with both compressors running and an output of 385 gallons per minute secured, an increase of 183 gallons per minute, or 91 per cent. over the normal pumping rate before the installation of the separators. The water delivered during this test contained a considerable amount of milky white dust in suspension, and at the time occasioned some inquiry from consumers as to the cause. As this is the only test which has ever been made with both compressors running, it is not known whether the milky matter, probably limestone, will disappear after more prolonged pumping, but it is assumed that it will. This method of pumping is considerably less efficient than with one compressor only, and is not to be considered for regular service, but as a reserve for emergencies is of much value.

In addition to increasing the water output, the separators also increased the operating efficiency of the plant, raising a given quantity of water with one-sixth less power. This is indicated graphically in chart I, by the greater separation between the water output and the power consumption lines immediately after the installation of the separator, particularly when compared with the same months for 1913.

This is also indicated on the lower line, denoting the power consumed in k.w. hours per thousand gallons.

The fluctuations in the lower consumption per thousand gallons are due largely to fluctuations in the well levels and to changes in atmospheric and other operating conditions. The water level in the wells drops when under heavy pumping, and there is a gradual receding of the water level in all strata underlying the Chicago metropolitan district. An air compressor operates most efficiently in dry, cold weather. Its efficiency in damp and warm weather is lower, and the cost of power proportionately higher.

Up to December, 1913, our power rate was $0.025 per k.w. hour. During that month a reduction was secured based on a sliding scale, with a maximum of $0.02. In addition to this 20 per cent. reduction there was secured a rebate of $1,020, payable at the rate of $85 per month for twelve months.

During the twelve months ending November, 1914, there was paid for power $4,779.53. Had there been neither a rate reduction, rebate, or separator installation, the cost of power for the twelve months, based on the conditions existing in November, 1913, would have been $7,776.25. Two thousand nine hundred ninety-six dollars and seventy-two cents has therefore been saved during the year, distributed as follows:

Saving in cost of power, December 1913-November 1914:

By rate reduction	$1,587.20
By rebate	1,020.00
By separator (5 months)	389.52
Total	$2,996.72

This is shown graphically in chart 2.

The saving effected by the separator averaged $77.90 per month, or $934.80 per year.

February, 1915.

BRICK PAVING ON STEEP GRADES

A REPORT OF RECENT PRACTICE IN TORONTO, ONT.

By F. A. Churchill, Conneaut, Ohio.

The use of brick paving on streets with steep grades is a problem on which a number of engineers have been working for some years. The hillside block has been devised by brick manufacturers for use in such localities, and this paper describes the methods of construction of pavements, in which a special form of hillside block was used, and the satisfaction given by it.

THE city of Toronto, Canada, is constructing vitrified brick pavements by day labor. The work is being done by the Department of Works, under the direct supervision of M. A. Stewart, assistant engineer of roadways, and W. Barber, superintendent of construction, with W. C. Perkins, M. Am. Soc. C. E., chief engineer of the construction department of the Dunn Wire-Cut-Lug Brick Company, as consulting engineer.

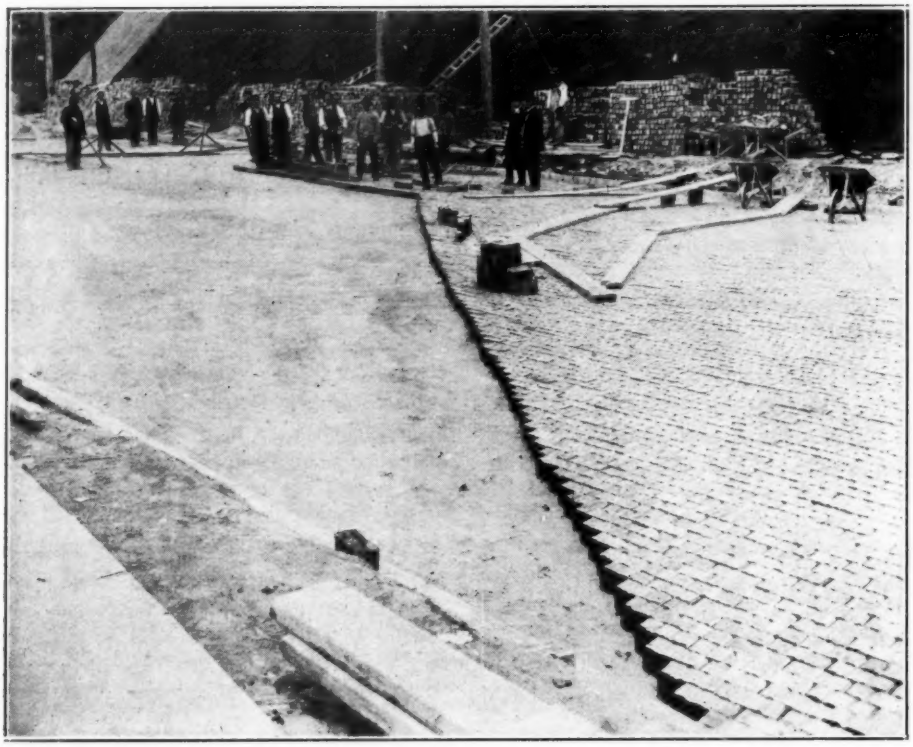
In Toronto, the long-debated question of the advisability of municipalities themselves doing constructional work on civic improvements of a major character, was long ago settled, whether success be defined in terms of dollars and cents or measured by standards of efficiency. Toronto now has a philanthropic motive in doing its own structural work. The war in Europe has borne heavily upon the business world in the Dominion, and thousands of men, women and girls are either out of work or are employed intermittently. The problem of caring for the worthy unemployed is a grave one. Canada is trying to solve the problem with courage, generosity and resourcefulness. It is said that the city of Toronto has had on its pay rolls six thousand men engaged in public works of various kinds, and the city will endeavor to give these men a daily wage as long as weather conditions permit.

The constructing of public improvements by day labor has been a blessing to thousands of wage earners, and has also proven to be sound economic policy, owing to the personnel of the engineering corps of the city government.

Up to the close of the year 1912 there were approximately 420,000 square yards of brick pavement in the city, laid on a concrete foundation varying from 4 to 6 inches in depth; 15,031 square yards laid on a broken stone base; 32,009 square yards laid on gravel. The first brick for paving construction was laid in 1895.

In 1913 there were 1,207,892 bricks laid. Of this number 727,160 were wire-cut-lug brick, the first laid in the city. They were first laid on Merton street, in North Toronto, from Yonge street to a point 2,300 feet east, as a test. The pavement was constructed 28 feet wide between curbs, on a 4-inch concrete foundation, with 1½-inch sand bed and cement grout filler, 1 to 1 mixture. A contract was let, on competitive bid, to the Bessemer Limestone Company, of Youngstown, Ohio, for repressed paving brick. Later the city satisfied itself that wire-cut-lug brick was preferable to repressed brick, and it asked the Bessemer Company to substitute the former for the latter at the same price.

In 1914 there were laid, by the day-labor organization of the city, approximately 1,523,200 regular wire-cut-lug brick, and 354,000 of the same brick by



CHRISTIE STREET HILL, *Toronto, showing method of laying hillside blocks lengthwise of street. Note how blocks break joint so that grooves do not match.*

contract, the only kind now specified. In 1915 it is anticipated that sufficient paving work will be projected to require approximately 4,000,000 brick; the realization of these hopes depending somewhat upon economic conditions resulting from the effect of the European war.

Toronto has made a notable departure in putting in a wire-cut-lug hillside brick pavement on Christie street hill, the second of the kind ever laid. This new type of brick combines the distinctive features of wire-cut-lugs, square edges and beveled ends with two transverse grooves, about three inches apart, on the wearing surface. The grooves are designed to give horses a foothold on steep grades. The bricks are laid longitudinally with the street. Joints are broken on each brick, so that, instead of extending in lines across the entire width of the street, as is the case with ordinary hillside brick pavement, each groove is no longer than the width of the brick. This affords shoe calks opportunity to get a grip almost anywhere, yet, as the grooves are broken up at short intervals, broad tires bridge them on alternate courses of brick and roll over the pavement without experiencing an appreciable jolt.

The United Brick Company, of Greensburg, Pa., in 1914 shipped to Toronto 143,000 wire-cut-lug hillside brick from their Conneaut (Ohio) plant, and another order of 100,000 has been placed for the steep grade in Bathurst street. The same company has the contract for furnishing wirelcut-lug brick in 1915.

Christie street hill has a grade of 6¼ per cent. It was paved 46 feet wide for a distance of 700 feet, with a double course granite block header at the base of the hill. The street curves on the grade, and the brick, running lengthwise with the street, were laid in such manner that the curves conform and run parallel with the curvature of the curb. The effect is extremely attractive, as will be

seen by an examination of the accompanying picture, which was taken before the pavement was grouted or rolled or cleaned off. No V-joints are needed on curves.

In structural details, the pavement has a natural sub-base; a 6-inch concrete foundation; a 1½-inch sand bed; cement grout filler, 1 to 1 mixture. Sand for the bed was taken from a cut on Bathurst street hill. The sand is extremely fine, but not gritty. It seems to be a sort of dry quicksand, but it is easily compacted into a firm bed, and shows no tendency to roll up or to mush in spots. At every stage of construction work the engineers were attentive to details, and every mechanical aid to good work was provided for the workmen.

The final constructional stage, the grouting, was given the close attention its importance demands. A rather coarse, well screened pit sand and a good quality of Portland cement were used for grout. These ingredients, 1 to 1, were first thoroly mixed dry and then they were reduced to the proper consistency by mixing with water in a grout box. The mixing in both instances was done by hand, and the grout in the box was stirred continuously until it was scooped out with shovels and poured into the joints of the pavement.

The grout box was a very serviceable and practical adjunct to construction, and as it differed from grout boxes in common use in the States, a brief description may be of interest to contractors. It is a rectangular box, made of planking, mounted upon two wheels about 12 inches in diameter and fitted with two 6-inch legs and two handles similar to wheelbarrow handles at the rear. The bottom joints of the box inside are finished with a triangular molding to prevent grout collecting in the angles. Because it can be trundled from place to place very easily, and because the wheels are so placed with respect to the axis of the box that the latter can easily be tipped so that the contents will flow to the lowered end of the box for scooping, the implement is both a labor saver and an aid to good construction. No grout was dumped. All was scooped and poured, a method which as-

CHRISTIE STREET HILL, *Toronto, looking up 6.25 per cent. grade. Wire-cut-lug hillside blocks not yet rolled or culled.*

CHRISTIE STREET, *Toronto, under construction. Laying wire-cut-lug hillside blocks on 6.25 per cent. grade, city work by day labor.*

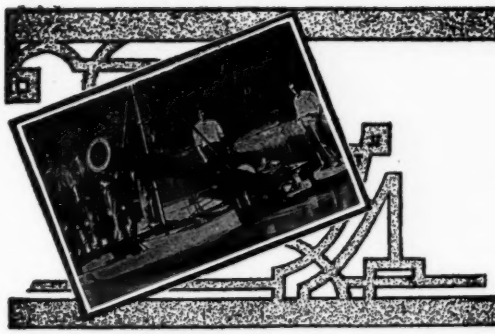
sures filling of the joints. In deference to the law of gravitation, grouting was begun at the foot of the grade, as otherwise the thin grout would have flowed down the longitudinal joints and overflowed the lower part of the pavement. Small quantities, by the shovelful, were poured at a time, and the surplus grout was quickly brushed forward up the grade. The final course of grout was squeegeed until the surfaces of the joints were flush with the pavement, care being taken to keep the joints full until the setting began. This assured a smooth, even surface.

After the final course of filler began to set, the transverse grooves in the brick were brushed out with wire brooms. The brushing was not really necessary, as the grout in the grooves wears out under the impact of horses' shoe-calks, but the process makes the grooves serviceable at once. The pavement was laid in November, 1914.

The Christie street hill is a beautiful piece of pavement, and its counterpart will be constructed on Bathurst street hill, possibly this winter, but certainly next spring. The level portion of Bathurst street, from the crest of the hill to Nina street, was paved with wire-cut-lug brick early in November, 1914.

The city safeguards itself in the purchase of materials by the competitive bidding system and also by submitting work to bidding by contractors, and some work is done by contract. It occasionally happens that the city rejects all bids as in excess of reasonable figures, and then readvertises. If the city finds that it can do its own work as cheaply as it can be done by contract, and is in position to handle it, the city does the work. This plan assures good work, as Toronto is fortunate in commanding the services of engineers who are not only capable but also conscientious.

February, 1915.



EDITORIAL

CENTRALIZATION AND LOCALIZATION

In local matters home rule has been demonstrated to operate successfully. An editorial last month noted the demonstration of this statement which has been made in German cities and the delays and losses due to centralized control by various State Boards in England. Part of the inefficiency in the English system is due to the fact that, while the field in which each Board acts in centralized, the Boards themselves have no definite centralized control and there is the usual consequent duplication and red-tape delay.

Some governmental functions are, however, of a general rather than a local nature, tho the carrying out of the work belonging to them is largely entrusted to the local authorities. Of such nature are common school teaching and road building and maintenance. In each case it is true that the details are taken care of by the smaller units of local government while, very properly, the general supervision, determination of qualifications of the workers in the field, checking of quality of results, and the like is or should be in the hands of the State authorities.

The State of Indiana exhibits the consequences of two methods of treating these matters, which, while very different in processes and in the materials with which the work is done, and in methods of measuring results, still have many points of view in common.

Some seventy years ago the schools were in the same condition as the roads are at the present time. Each township operated its own schools, each school district controlled its own school and selected its teacher thru the designated official, there being no method of determining the qualifications of the teacher, no standard of compensation other than the money available, no standard of determining the results of the teacher's work and changing them if wrong. One teacher would perhaps learn how to teach to be moved on and his or her place taken by another of little or no experience. The analogy with present township control of roads and repair of roads by the district supervisors is complete in every item named above.

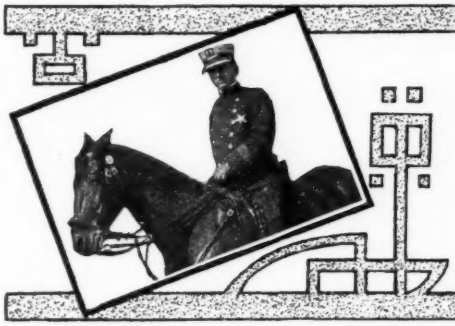
The school system of the State grew by the establishment of the county examiner to determine the qualifications of teachers; the State Superintendent to advise with county superintendents and teachers and aid personally,

in associations and by printed matter; the establishment of county institutes and of state schools for the instruction of teachers; the increase in requirements made of county superintendents in supervision and instruction of teachers; the continually increasing demands made of teachers as to preparation for their work and experience therein; the co-ordination and co-operation of city and country in bringing up the standard of instruction, in producing greater efficiency in methods of expending the money raised for educational purposes, in measuring results and changing methods to improve those results; the division of expense in part according to the desires and needs of the local communities, in part, especially as to supervision, according to the needs of the counties, and in part according to the population, especially as to funds derived from the State treasury more or less directly; the recovering of national aid and its distribution to localities thru a state authority.

All this program has taken seventy years to bring the school system to its present efficiency and the highly centralized system is now admittedly equal to if not the best in existencewhether measured by true economy of expenditure or by quality of results, demonstrating its high state of efficiency.

Every worker on the roads, every officer needed to secure efficient work, every process, method or result needed for efficient administration of the roads has its exact counterpart in the program laid down in the preceding paragraph. The present inefficiency in road work and extravagance in expenditure is due wholly to the fact that the road problem is just where the educactional problem was seventy years ago. It is to be hoped that the road question will not remain always seventy years behind, but that the lessons to be drawn from the development of one system can be applied promptly and rapidly to the development of the other.

It seems strange that two matters equally close to the hearts of the people, on which their advancement and prosperity depend to so great an extent should have had such different treatment. Possibly this is due to the less confidence of the people in their ability to manage all details of their educational activities, but that is doubtful. Possibly the difference lies in the early start made in educational lines when roads were so hopeless and money to make them was so infinitesimal that nothing could be done. Indeed, it is not thirty years since the first workable gravel road law was passed and the present really creditable condition of local roads in the State is the result of but thirty years of work. Just as in the school system, expert central guidance is needed to make the results more nearly commensurate with the expenditure of money and to bring to a higher quality and efficiency the main roads of the system which are in common use by the people and in only a very restricted sense local in their nature. It is no more just in the one case than in the other that the cities should be exempt from full participation in the cost of bringing up the portions of the system from which hey have the most benefit and the most direct benefit.



QUESTION DEPARTMENT

Forms for Electrical Inspection Work

I would like to get hold of a blank set of forms (applications for permits, etc.) such as used in connection with electrical inspection work in smaller cities. Can you furnish such a set, or refer me to a small city which is enforcing such an ordinance?

S., ———, S. D.

Will our readers send samples of the blanks they are using for the benefit of our correspondent? They may also be published for the benefit of others if permission is given.

Municipal Electric Light Plants.

Could you give me information about any of the following:

The lowest rate charged per kw.-hr. for lighting purposes by a municipally owned light plant in the United States;

The average charge in the United States per kw.-hr. by municipally owned plants compared with private plants.

We have a small town here of 5,000 people and own our water and light plant and the charge for current is 6 2-3 cents per kw.-hr. There is a movement on foot now to sell this plant and I am opposed to the sale and would like to get all the information I could that would be of help. If you could send me anything showing how towns had made mistakes, had their contracts broken, rates raised and unsatisfactory service I would very much appreciate the favor. B., ———, Tenn.

These questions open up the whole vexed question of municipal versus private ownership of public service utilities, but there will be no attempt to discuss them here.

The first question cannot be answered directly without giving a wrong impression. Thus, Cleveland proposes to supply electric current from its large municipal plant at 3 cents a kw.-hr., and has done so with fair success from two small plants supplying limited districts which it has had in operation for some years. The price named in the question would probably not be too high under ordinary circumstances in a city of the size named in the question.

The Bureau of the Census made a study of central electric light and power stations in 1902 which is out of date as to actual costs because of the great improvements made in electric lighting since that date, but it may serve to make some comparisons between the results of municipal ownership and private ownership.

Thus the average income per arc lamp in use for commercial or other private service was $48.88 in private plants and $41.46 in municipal plants per year. For incandescent lamps the average incomes were $2.40 and $1.92 respectively. For arc lamps in public service the incomes were $83.20 and $69.88 and for incandescent lamps in public service $6.06 and $5.93 respectively.

These incomes vary somewhat with the population. Thus in privately owned stations furnishing electricity only, arc light incomes per lamp were as follows:

Population.	Commercial Service.	Public Service.
Under 5,000	$53.80	$65.56
5,000 to 25.000	46.63	71.66
25,000 to 100,000	43.04	77.12
100,000 to 500,000	42.72	83.44
500,000 and over	58.82	111.97

For incandescent lamps the incomes were as follows:

Population.	Commercial Service.	Public Service.
Under 5,000	$2.53	$8.74
5,000 to 25,000	2.32	6.93
25,000 to 100,000	2.72	10.15
100,000 to 500,000	2.11	6.32
500,000 and over	2.33	2.24

In purely electric municipal stations the corresponding variations with population are shown in the following:

Incomes per arc lamp per year:

Population.	Commercial Service.	Public Service.
Under 5,000	$44.74	$61.27
5,000 to 25,000	40.67	64.79
25,000 to 100,000	35.77	51.88
100,000 to 500,000	....	70.24
500,000 and over	....	110.36

Incomes per incandescent lamp per year:

Population.	Commercial Service.	Public Service.
Under 5,000	$2.01	$7.62
5,000 to 25,000	1.70	5.46
25,000 to 100,000	2.54	3.99
100,000 to 500,000	0.87	4.96
500,000 and over	....	4.58

It will be noted that the incomes are less in the municipal plants in every case but one, indicating lower rates.

Municipal ownership is exercised mainly in the smaller cities. Of the 17,797 arc lamps reported in municipal plants, 16,734 were in use in plants in cities of less than 25,000 population.

Incandescent lamps in private service were largely 16-c.p., while those in public service were largely 32-c.p. or more and are burned more continuously, accounting for much of the difference between the incomes in the two classes.

Taking the outputs of current reported and the total incomes therefrom, the private plants seem to have received 3.35 cents per kw-hr. and the municipal plants 3.49 cents.

These figures can none of them be compared with any certainty of correct conclusions because of the differences in methods of accounting in use in private and municipal plants and in different plants in each class. Few plants, either public or private, make proper allowances for such items as depreciation and interest on investment, working capital and reserves for contingencies. Municipal plants have the added difficulty of making the proper allowances for public service, in many cases no such allowance being made and in others the allowance being insufficient.

It is quite possible in the case referred to in the question that these allowances have not been made and the plant is not giving satisfaction because it has not been kept up to date and in prime working condition.

A decision for or against selling the plant should be made, in a state not having a public service commission, only after a careful study by an expert of all the conditions and the careful working out of a franchise which will give the city rather than the company the advantage as to control. A franchise which will insure that the company will receive full compensation for the use of its capital actually invested and the ability shown in the management and will at the same time give the public and private consumers the best service possible for the money they pay for it is the best for both parties in the long run. It takes an expert unbiased in favor of or against municipal ownership to draw such a franchise.

Mere difference in rates offered by a company should not decide the question. That is a matter which should be open for revision at intervals sufficiently frequent to insure that the consumers get their share of the improvement in service or lowering of cost which comes so often in the electric lighting field.

Municipal ownership seems to be successful in proportion to the distance the plant is from political manipulation. In cities where this distance is great the successes are marked. In cities where the plant is a political football the failures are just as marked.

Reference may be made to the article on "A Modern Franchise for a Public Utility" elsewhere in this number of MUNICIPAL ENGINEERING for some suggestions as to the matters which should be included in a franchise in case it is decided to consider seriously the matter of granting one.

Permanent Water Meter Record

We are desirous of getting an office record for our meter readings separate from the record that the man that reads the meters uses and we are taking the liberty of addressing you to inquire if you can not recommend a good form for us. We would like if possible to get a form that will show two or three years' readings on the one sheet and also a sheet that has only one name on it. This is to be a permanent record of the office and something that is simple and that will contain all the information that would be required for a permanent record.

D., ———, Mont.

Forms of water meter records for office and for the meter reader will be found in MUNICIPAL ENGINEERING, vol. xlii, p. 251; vol. xliv, pp. 233 and 522, and vol. xlvii, p. 293. The last named is a reproduction of meter reading book page and meter reading record published by the Buffalo Meter Co., Buffalo, N. Y. The American Water Works Bookkeeping System contains the best book for keeping the accounts of metered water customers, including the meter readings copied from

the meter readers' books, the amounts due and payments made. It is published by Engineering Publishing Co., 702 Wulsin Bldg., Indianapolis, Ind.

Gravity Concrete Mixers

I would like to know the names and addresses of several companies making gravity mixers, for making concrete, such as the Gilbreth Trough Mixer, described in the book "Concrete Construction" by Gillette & Hill.

P., ———, Porto Rico.

Inquiry may be made of the following firms: Automatic Concrete Mixer Co., 143d street and Southern boulevard, New York; Buffalo Concrete Mixer Co., Buffalo, N. Y.; Hains Concrete Machinery Co., 286 Fifth avenue, New York; Ransome Concrete Machinery Co., Dunellen, N. J.; Littleford Bros., 444 East Pearl street, Cincinnati Ohio; Union Elevator & Machine Co., 214 West Ontario street, Chicago, Ill.

Box Car Unloaders and Conveyors

Can you give me the address of several reliable parties or firms making box car unloaders suitable for unloading sand, soda-ash and lime into storage bins whose loading doors are closely adjacent to the tracks and are on the same level and conform to the shape of the box car doors?

At present we unload these materials from box cars into storage bins, the floors of which are on the ground level. The material is shoveled or wheeled in wheel barrows from the box car into the bins, which, of course, keeps the top level of the stored material from being much above the floor level of the car and requires a large floor area to store any considerable quantity of any of the materials. From the bins the materials are again loaded into wheel barrows, weighed and dumped into a pile in certain proportions and mixed by hand and again loaded into wheel barrows and wheeled to the back of the melting tanks and dumped and then shoveled into the tank hoppers to be melted.

Now we want to get away from all this handling by hand and have in mind a system of which I am asking you to supply me the names of concerns manufacturing the detail parts. We are thinking of a plant whereby we can mechanically unload the materials we use from box cars, each material into its respective hopper, from which it will be fed either into a vertical chain bucket elevator or elevator of some other type and elevated into storage bins some thirty or forty feet high. The various materials will then be fed by gravity out of these bins to a scale and weighed and then onto a conveying belt and to a mixer and mixed. The resulting mixture will then be elevated and carried by conveying belts to the backs of the various melting tanks and dumped into hoppers, which will feed by gravity into these tanks.

P., ———, Ind.

This seems to be a problem in conveying materials which should be solved with ease by the experts in picking up and conveying materials. Such firms as Austin-Western Mfg. Co., Chicago, Ill.; Thos. M. Roche, 829 Monadnock Block, Chicago, Ill.; Jeffrey Mfg. Co., Columbus, O.; Webster Mfg. Co., Tiffin, O.; Chain Belt Co., Milwaukee, Wis.; Link-Belt Co., Nicetown, Philadelphia, Pa.; C. O. Bartlett & Snow Co., Cleveland, O.; Robins Conveying Belt Co., 13 Park Row, New York, and others can supply designs as well as all or part of the machinery necessary.

Electrolytic Sewage Disposal

In your issue of February, 1913, p. 135, you describe "Municipal Plants for Electrolytic Sewage Purification." This article has appealed to me very much as being the proper method of sewage disposal for cities that are situated in an agricultural district. I would like to know if the process is patented, and if so, who is the patentee, and where could I reach the party by letter. We have in a radius of 100 miles some seven or eight cities with a population of from 2,500 to 20,000 inhabitants where the above described process appeals to me as being the only satisfactory solution of the sewage problem. Nearly all of these cities are polluting fresh water streams that are used largely for irrigation purposes, as well as domestic supplies. Complaints are becoming so numerous from the agricultural districts that use this polluted water that the city officials of the different cities will be compelled to abandon the present method of disposal.

L., ———, Wash.

The writer has tried to obtain definite information from those interested in the electrolytic process of sewage treatment described in the above mentioned article and has been promised a full description when the Oklahoma City plant was put in good working order. Nothing having been received, it is presumed that the plant has not yet been made successful. The city engineer of Santa Monica, Cal., or H. V. Hinckley, consulting engineer, Oklahoma City, Okla., can possibly put inquirers in touch with the designer or patentee of the system.

Safe Specifications for Reinforced Concrete Sewer

Will you kindly tell me if the following specification for a drainage ditch is safe?

This work to be monolithic. Greatest depth about 14 ft. The sections to be round and the walls the same thickness clear around. Mixture 1-5 gravel concrete and the ditch runs rock, clay, sand and gravel with ground water.

The walls of the 72-in. and 60-in. arch are to be 5-in. thick, the walls of the 54-in. and 48-in. arch are to be 4-in. thick, the walls of the 42-in. arch are to be 3½-in. thick and the walls of the 36-in. arch are to be 3-in. thick. All walls to be reinforced with No. 9 wire fencing with meshes 6-in. by 8-in., equal to 0.2 lbs per sq. ft.

B., ———, Ind.

At its last convention, held in Boston in October, 1914, the American Society of Municipal Improvements adopted standard specifications for sewer construction, and this drainage channel is deep enough below the surface to require the same

strength of conduit walls as a sewer would.

The section relating to thickness of reinforced concrete sewer pipe was not adopted, because the thickness proposed by the committee preparing the specifications was considered to be greater than is necessary, by the manufacturers of reinforced concrete pipe. They presented their idea of the proper thicknesses and the section was laid over for further consideration, and will come up for amendment and adoption at the next convention to be held in Dayton in October, 1915.

The following table shows the thicknesses of pipes of various diameters proposed by the committee and by the pipe manufacturers:

Diameter of pipe, inches.	Thickness in inches proposed by Committee	Manufacturers
24	3	2.5
30	3.5	2.75
36	4	3
42	4.5	3.5
48	5	4
54	5.5	4.5
60	6	5
66	6.5	5.25
72	7	5.5
78	8	5.75
84	8	6

It will be noted that with two exceptions the thicknesses proposed by the manufacturers agree with those given in the question, and in those two cases are 0.5 inch greater.

The section governing proportions of materials reads as follows: "The concrete used in the manufacture of cement concrete pipe shall be composed of a mixture of the best quality of portland cement, clean, sharp sand, and clean broken stone or gravel suitably graded and equal in quality to similar materials specified herein for concrete, and properly proportioned to produce a pipe that will comply with all the requirements specified in sections named, (governing method of making, tests and dimensions).

The sections governing reinforcement provide that the steel shall comply with given requirements of the American Society for Testing Materials; that it shall be either expanded metal, rods or wire mesh, equal in quality and design to that manufactured by the American Steel and Wire Company; that in pipes 24 to 48 inches in diameter the reinforcement shall be placed 1 inch to 1.5 inches from inner surfaces, according to diameter of pipe and that either one or two lines of reinforcement may be used; that two lines of reinforcement shall be used in pipes over 48 inches in diameter one 2 inches from the inner surface and one 1.75 inches from outer surface.

While it is probable that reinforced concrete pipe in length may be made better than continuous reinforced concrete pipe made in place, the thicknesses for the latter would not vary greatly from those for the former under the same conditions, and the absence of joints in a water-bearing, sandy soil might be a considerable advantage in favor of the latter.

Unless there are special reasons for requiring greater than the standard strength in the particular case described, either of the specifications given in the table should secure a sewer or drain of sufficient strength.

Proportions of Lime Mortar

Will you please advise us if you publish any tables showing the ingredients required to make one (1) cu. yd. of lime mortar in the various proportions, such as one part lime to 1-2-3 of sand. We desire these tables to show the proportions by weight of dry sand and lime. The quantities of sand may be expressed in terms of cubic yards, estimating the sand to weigh 100 lbs. per cu. ft.

We have in our office a table of this kind on Cement Mortar, prepared by Mr. L. C. Sabin, Asst. U. S. Engineer, and we are trying to secure the same kind of information applicable to lime mortar.

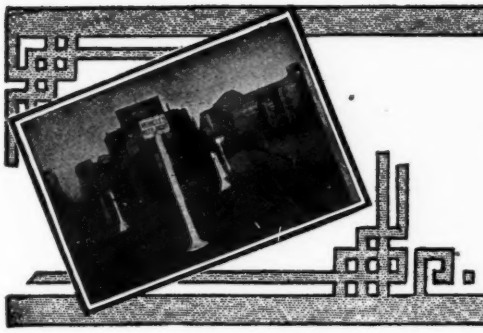
We are after authoritative information and if you have no tables of the sort above described, any information directing us will be appreciated. L., Pittsburg, Pa.

The writer does not know of tables of the kind mentioned. Merriman's "American Civil Engineers' Pocket Book" ($5) states that the lime in commercial barrels of about 200 pounds net will make about 2½ barrels of stiff lime paste. One barrel of the paste and three barrels of good sand will make about three barrels (0.4 cubic yard) of mortar. One barrel of unslaked lime will make about 0.95 cubic yard of 1:3 mortar. From the first statements made the barrel of unslaked lime would make about one cubic yard of mortar when mixed with 7½ barrels of sand. Also a barrel contains 0.133 cubic yard, or 3.6 cubic feet.

Baker's "Masonry" ($5) gives 2¼ barrels of paste from one 230-pound barrel of unslaked lime.

Can our readers refer our correspondent to a source of the desired information?

An article in MUNICIPAL ENGINEERING, vol. xxviii, p. 4, gives comparisons of strength of high calcium and dolomite lime to the advantage of the latter, but does not give any information as to volumes of the mixtures used. The "Hand Book for Cement Users" gives the same information and statement of trade customs regarding hydrated lime.



WORKERS IN THE FIELD

How to Apply Filler to Vertical Fiber Brick Pavement

The Editor of MUNICIPAL ENGINEERING:

Sir—I note in the Question Department of the January issue of your magazine the article on laying vertical fiber brick pavements, and also that the question is asked, "Just how should asphalt be flushed on and how much asphalt per square yard should be used where paving is laid on 1½-inch sand cushion?"

Vertical fiber brick are laid flat instead of on edge, have a recticulated or roughened surface, and the bricks are laid and rolled as is usual with brick pavements, and the asphalt in this type of construction is applied somewhat differently. Instead of using a pouring can and filling the interstices, a little different grade of asphalt than the ordinary asphalt filler is used and is poured from an ordinary bucket directly onto the brick, and it is pulled over the surface of the brick while hot by the use of a squeegee. It is necessary that the asphalt be extremely hot and have a wide range of temperature between its melting and congealing points in order to allow of the asphalt filler penetrating the interstices of the brick before congealing.

We are sending you under separate cover a copy of our asphalt filler book and would ask that you refer to pages 9, 11, 13, 15 and 17, which outline the specifications for asphalt filler for brick pavements, together with the method of application. G. L. SCHOMBURG,
Paving Department, Standard Asphalt & Rubber Co., Chicago, Ill.

The following extracts from the booklet referred to will show the differences between the asphalts used for filler in ordinary brick pavements and in vertical fiber brick pavements, also the differences in methods of application, based on the experience of the company with which our correspondent is connected:

For ordinary repressed brick or block pavements, the following specifications are recommended:

The interstices, or joints, of the brick (or block) shall be completely filled with Sarco asphalt filler, or any asphalt filler equal thereto, which must conform to the following standard of quality:

(a) It shall contain not less than 98 per cent. pure bitumen soluble in carbon disulphide (CS_2).

(b) Of the total amount soluble in carbon disulphide (CS_2) 98½ per cent. shall be soluble in carbon tetrachloride (CCL_4).

(c) When tested with a No. 2 needle weighted with 200 grams operating for one minute at 32 degrees Fahrenheit, it shall have a penetration greater than twenty-five (Dow method).

(d) When tested with a No. 2 needle weighted with 200 grams operating for seconds at 115 degrees Fahrenheit, it shall have a penetration greater than eighty.

(e) When tested with a No. 2 needle weighted with 100 grams and operating for five seconds at 77 degrees Fahrenheit, it shall have a penetration between the limits of thirty-five and fifty.

(f) Its specific gravity at 60 degrees Fahrenheit shall be greater than .975 and less than unity.

(g) It shall have a melting point not lower than 225 degrees Fahrenheit.

The filler shall weigh not less than eight nor more than eight and one-half pounds per gallon at 60 degrees Fahrenheit. It shall remain ductile at all climatic temperatures to which it shall be subjected, shall be water-proof, acid-proof and impervious to street liquids. Shall adhere firmly to the brick (or block) and be pliable rather than rigid, thus providing for expansion, contraction and all traffic conditions.

The filler must be heated sufficiently to allow proper pouring or squeegeeing (about 400 degrees Fahrenheit), taken from the kettles in buckets and poured from pouring cans.

The contractor must be equipped with pouring cans especially designed for this purpose.

Before pouring the asphalt filler care should be taken to see that all bricks (or blocks) are in a bone-dry condition.

All joints at both sides and edges of the bricks (or blocks) must be filled completely by pouring or squeegeeing the material directly into and flush with the top. The material as poured shall be at a temperature of not less than 350 degrees Fahrenheit nor more than 400 degrees Fahrenheit. As the work progresses and while the material is still hot there shall be sprinkled over the entire surface a layer of clean, dry sand (preferably heated).

The filler is poured in the joints of the brick from specially prepared cans, which consist of a funnel-shaped receptacle, narrowed down to a tip at one end, furnished with a handle projecting from the other, and a valve-rod controlled by the operator for opening the delivery at the end tip.

The pouring is done by placing the tip in the joint of the brick, walking slowly backward, at the same time allowing the filler to flow so as to completely fill each joint. The tip rests in the joint and will therefore act as a guide, preventing the spilling of the material on the surface, provided reasonable care is taken.

For vertical-fiber brick pavements:

The asphalt filler used in the construction of a repressed brick or block pavement would not suffice for the vertical fiber brick, inasmuch as the asphalt filler is not only placed in the interstices of the brick, but is applied to the surface, and, consequently, must cope with different conditions.

The application of the asphalt filler for a vertical-fiber brick differs slightly from the method employed for a repressed brick or block.

The asphalt filler is heated in the same manner but is brought on to the work in open buckets and is poured on the surface of the brick in a semicircle with a dragging motion. Men equipped with iron squeegees, which are heated to a glow—and these squeegees must always be very hot—pull the asphalt filler toward them over the surface of the brick, leaving as little as possible on the surface, not to exceed an eighth of an inch.

A hill of sand is spread from gutter to gutter directly behind the men with the squeegees, and immediately after the filler is applied, and before it has had its initial set, the sand is pushed over the asphalt, allowing one-half of an inch of sand to remain on the surface. This sand will be gradually forced into the asphalt coating by traffic and will add to its stability.

The following asphalt filler specification is recommended for vertical-fiber brick:

The interstices of the brick, as well as the joints next to the curb, railroad tracks and around manholes or other street structures, shall be completely filled with an asphalt filler complying with the following requirements:

The asphalt filler shall be composed of asphalt containing at least 98 per cent. of bitumen soluble in carbon bisulphide. At least 98½ per cent. of the contained bitumen soluble in carbon bisulphide shall be soluble in cold carbon tetrachloride. The penetration shall be uniform in consistency and shall not vary more than seven and one-half points in penetration from the following standard:

No. 2 needle, 1 minute, 200 grams at 32 degrees Fahrenheit, 30.

No. 2 needle, 5 seconds, 100 grams at 77 degrees Fahrenheit, 40.

No. 2 needle, 5 seconds, 50 grams at 115 degrees Fahrenheit, 60.

The above filler shall be water-proof, shall adhere firmly to the brick both in the joints and on the surface, and shall remain ductile and pliable at all climatic temperatures to which it may be subjected. It shall not run in the joints during the hottest summer weather nor become hard or brittle when cold. The melting point shall be not less than 225 degrees Fahrenheit nor more than 275 degrees Fahrenheit. The brick shall be dry and the asphalt filler shall be applied at a temperature of not less than 375 degrees Fahrenheit nor more than 450 degrees Fahrenheit by means of hot squeegees especially adapted to the purpose. The joints shall provide sufficient hot material on the top surface to fully cover the etched or reticular surface with a thin coat of the hot asphalt.

A top dressing of one-half inch of coarse dry sand (preferably heated) shall be spread immediately after the filler is applied, and before it has had its initial set, and shall immediately be rolled with a roller weighing not less than three nor more than five tons until the sand is thoroly embedded in the asphalt filler. As soon as the sand has been thoroly ground into the top dressing of asphalt by traffic the surplus may then be swept clean.

Ordinances Regulating Street Excavating—Replacement by City.

The Editor of MUNICIPAL ENGINEERING:

Sir—In the January issue of Municipal Engineering, page 40, we find a letter asking for information as to latest improved ordinances regulating excavations and improvements made by gas companies, etc., together with the statement that the writer knows of no such ordinances and asking if any reader can furnish same.

We herewith attach copy of portions of the ordinance under which we are working relative to this subject and under which the street department of our city

backfills all excavations and replaces all pavement at the expense of any public utility company or other party requesting the cutting of such pavement. This ordinance works very satisfactorily with us and has relieved the city of the frequently disputed question of responsibility for settlement of pavement and as to whether same was caused by excavations thereunder, etc.

The city, doing all this work itself, keeps experienced men for such work, does its work thoroly and very seldom experiences any trouble over settlements. Utility companies and others appreciate having the work done by such experienced men, thus relieving them of any responsibility in connection therewith.

In our annual report for 1914 you will find further reference to this matter, together with other information which may be of interest in this connection.

CHAS. R. CASE,
Supt. of Streets and Sewers,
Seattle, Wash.

The portions of Ordinance 25150 relating to backfilling and replacing pavement cut read as follows:

"Section 5. That in all cases where the city of Seattle shall have acquired assignments in whole or in part of any such maintenance contract, the superintendent of streets, under the direction of the board of public works, shall make all repairs in the pavements necessitated by reason of cuts and openings made therein in laying or relaying any gas, sewer or other pipes or conduits by persons thereunto authorized by permit. Before any such permit shall be issued for the breaking up or opening of any pavements, there shall be deposited by the applicant in the guaranty deposit fund a sum of money equal to $2.00 per cubic yard for each yard of earth to be used in the backfilling of any such opening, $5.00 for the first square yard of pavement necessary to be broken up and $3.00 per square yard for each yard of pavement after the first yard so to be broken. Upon the laying down of said gas pipe, sewer pipe, water main or other pipe or conduit in accordance with such permit, the superintendent of streets shall immediately take charge of the trench in which such pipe or conduit shall have been laid and shall proceed to refill same and repair the pavement thereon. Upon the completion of said work by the superintendent of streets, a verified statement of the cost thereof shall be furnished to the city treasurer and one copy of which shall be filed with the city comptroller. (Upon the completion of such work by the superintendent of streets, he shall certify such fact to both the city treasurer and the applicant, with an itemized statement of the cost thereof.) The city treasurer shall thereupon, upon the surrender of said original guaranty deposit voucher, without further ordinance or order, pay to said applicant the balance that may be due as excess on said deposit. In computing the charge to be made for such work, there shall be added, by the streets and sewers department, the sum of 10 per cent. of the actual cost of such labor.

"Section 6. Instead of making deposits in advance for each and every cut or opening to be made, as provided for in Section 5 hereof, and as an alternative thereto, any person, company or corporation desiring so to do may deposit with the city treasurer from time to time to the credit of the department of streets and sewers the sum of $500 and shall replace said sum from time to time whenever such person, company or corporation shall have been notified by the street and sewer department that the amount of such deposit remaining shall have been reduced to the sum of $50 or less. Such deposits shall be used in the same manner as set forth in Section 5 hereof."

From the annual report the following facts are gathered:

"The year's average shows a cost of 93.3 cents per square yard for repairs to cuts and worn holes in asphalt pavements, and $1.9167 for brick pavements."

"Side-sewer contractors have heretofore been required to put up cash deposits for backfilling and replanking or repairing cuts made in streets. We have eliminated this method and are holding bondsmen of such contractors liable for all such bills.

"In the case of the larger building contractors, instead of each department requiring a cash deposit to protect itself against unpaid bills for work done or damage to city utilities, we have encouraged the filing of a bond covering all these matters, we notifying other departments of the filing of such bond and their protection thereunder.

"Deposits are still necessarily required of smaller contractors using streets as a protection against damage to same and a cleanup upon completion."

Some idea of amount of work may be derived from the following figures taken from the numerical reports of work done, cost and bills:

The amount received from contractors and others for repairs to asphalt pavements was....	$4,249.09
General bills for repairing and cleaning streets, work done and supplies furnished, 11 months, to Dec. 1, 1914.....	15,111.43
General bills for repairing and cleaning sewers	1,757.58
Interdepartment bills for cleaning and repairing streets.....	4,467.14

Inter-department bills for cleaning and repairing sewers.....	61.78
Amounts received from contractors and others for work done by the department for them were as follows in maintenance:	
Departments	17,781.63
Planked streets.....	1,143.95
Dirt streets	652.99
Sidewalks	1,817.77
Sewers and drains.....	1,819.36
The inspection division released guaranty deposits for use of streets amounting to.....	15,530.75
Permits issued to franchise holders for street work.....	235
Sewer extensions inspected.....	309
Orders to backfill sewers.....	179
Permits issued for sewers.....	1,948
Permits issued to repair sewers.	52

Sir—In your issue of January, 1915, an article appeared relative to "Ordinances Regulating Street Excavations." I am sending you a copy of an ordinance regulating these matters in our city and wish to say that this ordinance has given good satisfaction here, both to the gas and water companies and plumbers, as well as to the public.

ELMO A. FUNK,
City Engineer, Anderson, Ind.

Ordinance No. 811.

An ordinance to regulate the digging of trenches and other excavations in the public streets, alleys and sidewalks of the city of Anderson, Indiana, and providing penalties for its violation.

Section 1. Be it ordained by the common council of the city of Anderson, Indiana, that hereafter it shall be unlawful for any person, firm, or corporation to dig any trench or to make any excavation of any kind whatsoever in any of the public streets, alleys, or sidewalks of the city of Anderson, Indiana, without first obtaining a written permit from the city engineer to do so.

Section 2. For the purpose of obtaining such written permit the person, firm or corporation desiring the same shall file with said city engineer a statement in writing to be signed by such applicant and setting forth the time when such excavation is to be made, the place where same is to be made and the purposes thereof and the approximate dimensions of the same.

Section 3. At the time of securing such written permit from the city engineer and before the same shall be issued, the party applying for the same shall pay to the city controller of said city a sum in cash sufficient to pay and defray the expenses of refilling such trench or excavation so as to leave such street, alley or sidewalk in the condition that same was in before such trench or excavation was made. Such estimate shall be made by the city engineer and the amount estimated therefore shall be paid by the applicant to the city controller, and his receipt therefore shall be presented to the city engineer, who shall then issue such permit. As soon as such trench or excavation is ready to be refilled the person, firm or corporation to whom such permit was issued shall immediately notify the city engineer, who shall cause the same to be refilled and resurfaced by street committee of said city under the direction and supervision of said city engineer. That portion of said deposit not required to refill such trench or excavation shall be returned by city controller to person paying same.

Section 4. Anyone violating provisions of this ordinance shall be fined in any sum not less than $10.00 nor more than $25.00. This ordinance shall be in force and effect from and after its passage and publication as required by law.

Disposal of Garbage and Refuse in Seattle.

The Editor of MUNICIPAL ENGINEERING:

Sir—Your communication addressed to Mr. A. H. Dimock, city engineer, regarding disposal of waste has been referred to this department for reply.

We are at present disposing of our garbage and waste by making sanitary fills, or at least of all but sixty-five tons per day, which is incinerated. This is light material and such as would be difficult to dispose of at the present fills on account of their location.

This method of filling works very satisfactorily in this climate, but I believe it is necessary to include all waste materials, as ashes, boxes, tin cans, etc. These all assist oxygenation and nitrification. I do not believe pure garbage can be handled in this way.

We also find that it is best to keep as little of the face of the fill exposed as possible. It is always best to keep a man constantly on the job, whose duty it is to rake down to the bottom of the fill all boxes, rough materials, etc., thus leaving the ashes to form a covering on top. When this is not sufficient we cover with a layer of earth about five inchces thick.

The success lies in the proper mixture of waste materials, and next the fill must be properly covered to protect from flies. Chemicals can also be used to protect same. This covering also prevents the slight sour odor of fresh garbage, and, by keeping out the sunlight, at the same time encouraging bacterial growth by increasing the warmth inside of fill. People residing within one hundred feet of

these fills make no complaint, but the public has to be educated when you first adopt this method. We aim to fill city property, as ravines, swampy land or docks on the lake or salt water front.

Enclosed find copy of our laboratory findings, which will show that the process is simply one of slow incineration by nature instead of the expensive method of burning by incinerators, and at the same time will help to prove that there is nothing detrimental to public health in these fills.

We have eleven fills distributed over our city, thus making short hauls, and these are taken care of by eleven laborers, disposing of approximately three hundred and fifty tons per day by this method alone, while one incinerator with about an equal pay roll will only dispose of sixty to seventy-five tons per day, running twenty-four hours. A fill increases the value of property, while the refuse from our incinerator has to be hauled away at an added cost.

J. S. McBride,
Seattle, Wash.

Following is the chemist's report referred to:

Results of chemical examination of samples of "garbage borings" submitted to this laboratory for examination:

Three months old:

Sample Number	Moisture, Per Cent.	Organic Matter (Unburned Coal), Per Cent.
1.....	26.17	16.26
2.....	24.29	18.79
7.....	29.86	10.02

The samples as submitted consist almost entirely of the ash of coal carrying considerable moisture and some organic matter in the shape of unburned coal.

The samples carry only traces of decomposing or fermentable organic matter.

Six to eight months old:

3.....	29.40	8.79
4.....	24.90	7.80
5.....	32.46	9.10
6.....	33.03	10.02
One year old:		
8.....	15.00	12.41
Eighteen months old:		
9.....	8.33	7.32

The organic matter in the above samples consists almost entirely of carbon or unburned coal.

The samples contain very little of a fermentable or decomposing nature.

The decomposing matter in the above samples would in all probability not amount to over 0.1 per cent.

A. Jacobson,
City Chemist.

Graphic Methods for Presenting Facts

The science of presenting facts to the eye so that they will impress the mind of the non-scientific observer more clearly, has developed rapidly of late years. For many years this method of making comparisons was open only to the trained mathematician, but now the mathematics are all taken out of it as to the reader or observer and the making of the graphical charts is largely reduced to rule.

There are suitable and unsuitable methods to use, however, and the clearness of the exposition of the subject illustrated depends upon the proper selection of the method. Then, too, it is quite easy to give wrong impressions by improper manipulation of graphical methods, even if the exact facts and only the exact facts are shown.

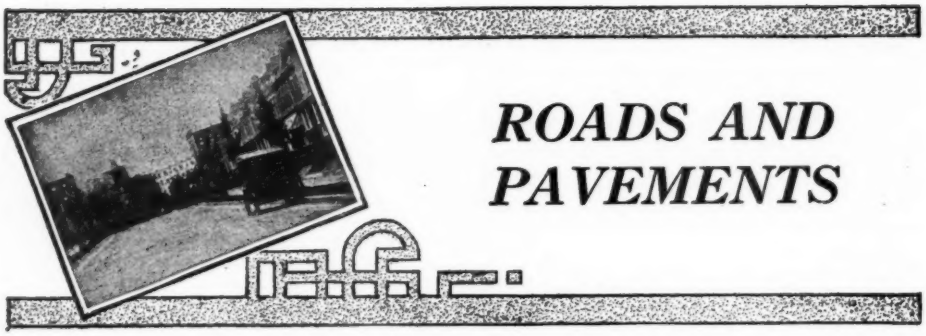
The science, as it has been developed today, is fully set forth in Willard C. Brinton's book on "Graphic Methods for Presenting Facts," which fully explains the uses of various simple graphical devices and the misuses often made of them.

The principal devices described are the horizontal bar, the circle and sectors, separate bars, horizontal or vertical, totaling 100 per cent., charts giving numerous subdivisions, organization charts, routing charts.

Simple comparisons of quantities of one, two or three dimensions are made and various methods of making such comparisons are compared and contrasted, showing when they are suitable and when not. The plotting of curves to show continuing processes or provisions of facts, with full discussions of the proper units to use in making the drawings, occupies several chapters. The explanations are so full and clear that the unmathematical reader can learn to understand the showings of the curves if not to construct them himself. The mathematical reader has a full treatise on the tools thus put into his hands which should make him expert in showing facts by graphical methods and in making true comparisons

Maps and varieties of shading to show various kinds of information are fully described and illustrated.

General methods for collecting and tabulating data in order to get them into understandable form, preparation of charts, instructions to engravers in reproducing them for publication, making of titles, statement of scales and of relations of them to each other; in short, all the details from the selection of facts to collect to the publication of those facts in printed form are given in full detail and clearly so that any one wishing to avail himself of the graphical methods of presenting facts will find full instructions for all steps in the process.



ROADS AND PAVEMENTS

Tests vs. Inspection of Treatment of Creosoted Wood Paving Blocks.

A Paper by Frank W. Cherrington, Engineer for Jennison-Wright Co., Toledo, Ohio, before the American Wood Preservers' Association.

Is the collection and analysis of creosote oil, extracted from creosoted wood paving blocks after treatment, a reliable calculation as to the initial quantity actually injected inside the blocks, during the process of treatment?

The desired degree of accuracy, relating to the average quantity of injected creosote oil per cubic foot of timber, cannot be reached by the laboratory extraction and analysis of creosote oil, after its injection into wood.

Owing to the remarkable variation in the structure of wood it is only possible to determine accurately the average quantity of creosote oil injected per cubic foot of timber, by close observations of the proper treating gages and automatic feeding devices at the creosoting plant during the actual process of treatment.

The composition of the timber is of so complex a nature that scarcely two wood paving blocks are identical in structure, even when cut from opposite ends of the same plank of average commercial length. This is true, regardless of the most careful commercial specification as to lumber, limiting the percentage of heart-wood, number of annual rings to the inch, etc. Therefore, altho treated under the same temperature and same pressure, scarcely two wood paving blocks will have the same degree of penetration or absorption.

The reasons for the variation in the structure of wood blocks sawed from the same species of wood, whether taken from the same tree, or from widely separated growths, are difficult to explain, but a few of the more obvious reasons are here cited.

It is very evident that some of the blocks are necessarily manufactured from timber coming from the heart of the tree and some from the exterior portions of the tree. The even dry weight of sapwood is often but two-thirds that of the heart-wood. A cross section of a truee cut from its base will be of an entirely different structure from the cross section cut from the middle or top. Timber growing on the side of a hill will be different from that growing on high or low ground. Some trees will grow at the edge of the forest and others in the interior. A piece of timber cut from the north side of a tree will show a different structure from that cut from the south side. A rapidly growing tree will have a different structure than that of a slow growth timfer of the same species. Thus it is seen that environment is largely responsible for the complexities in the wood structure of a tree.

A quotation from Bulletin 101 of the Forest Service, United States Department of Agriculture, relating to "The Relative Resistance of Various Conifers to Injection with Creosote," follows:

"It is very difficult and sometimes apparently impossible to secure uniform treatments of wood with preservatives. If, for example, an average treatment is given of ten pounds of creosote per cubic foot, some pieces of wood in a charge will take twice the average amount, while others will receive less than half of it."

An average carload of creosoted wood paving blocks will contain approximately 300 square yards, or 15,000 individual blocks. The chemist in making analysis after the blocks are treated and have arrived on the work, selects perhaps a dozen, but rarely two dozen, blocks from the car at random. The creosote oil is then extracted and analyzed as to both quantity and quality, and the result accepted as the average oil content per cubic foot in the 14,976 other blocks. If as many as two dozen blocks are selected out of the entire car as samples, they will represent but 0.16 of 1 per cent. of the total number of blocks in the car.

The government bulletin above referred to also states that "in general long leaf

pine was found to be erratic in its penetration and absorption of creosote."

The above citation from the government, and the listing of but a few of the factors affecting the structure of wood, prove the futility of selecting a few wood paving blocks for analysis, after the injection of the oil, as representative of the average penetration and quantity of oil that may be secured on the entire car. The blocks selected for analysis may be all heart or all sap, with large or small quantities of resin, etc., and the chance of a wide deviation from the true average is great.

The final result obtained from a laboratory analysis is liable to be in error. The human element, volatility of the creosote oil, difficulty in separating the injected creosote oil from the natural resin, impossibility of extracting all of the injected oil, etc., etc., all tend to reduce the precision of the result. The possibility of an error in laboratory extraction and analysis, combined with the variation of the wood structure, doubles the chance for inaccuracy and detracts from a precise estimation of the average amount of creosote oil initially injected into the wood.

Records showing the average quantity of creosote oil actually injected into the wood blocks at the plant during the treatment, when compared with the results showing the amount of oil extracted by laboratory analysis from selected samples, representing an exceedingly small proportion of the entire number of blocks treated, will naturally show a decided variation.

When laboratory analyses are accepted by the consumer as absolutely conclusive, regardless of whether or not an inspector has been present to check the actual injection of the oil at the plant, creosoted wood blocks are often rejected, when the manufacturer has conscientiously and closely followed the required specification.

Directly bearing on this subject, is the following excerpt taken from a report by Wm. W. Marr, assistant engineer of streets, Board of Local Improvements, Chicago, Ill., entitled "Repaving the 'Loop' District in Chicago with Creosoted Wood Blocks," which, of course, anticipates a proper selection of the timber, oil and treatment, in accordance with good practice:

"Many blocks, on being split for the purpose of making mitres or closures, show white on the inside and appear to have received very little treatment. This is a cause of a great deal of complaint from those who are not familiar with the reason for blocks having this appearance. As a very great number of blocks are treated at one time, it is not reasonable to suppose that a few blocks could have received a less pressure and treatment than the balance of the blocks received; so it can safely be assumed that the blocks which do not show so great a penetration as the rest are simply incapable of taking the oil on account of their pores being already filled with resin. Blocks of this sort have never given any trouble and are consequently never rejected."

Modern creosoting methods employ the treatment at one time of some thirty thousand (30,000) individual, and very different paving blocks. These are placed in the same creosoting cylinder and subjected to the same temperature and same pressure. It is impossible to give each block an individual treatment, and since blocks of varying structure must be treated collectively, it is but consistent to insist that an extremely small proportion of the whole, selected at random for analysis, cannot be conclusively indicative of the average absorption secured by the treating plant engineer on the entire charge.

Supply and Use of Water in Concrete Road Building

From a Paper by C. D. Franks Before the Indiana Engineering Society.

It is often the case that a concrete roadway or other hard surfaced road is to be placed upon an old roadway, when the new road is wider than the old roadway has been. Where such a condition exists it will be necessary to loosen thoroly the old roadway for quite a distance below the desired surface of the finished sub-grade, this distance to depend upon soil and other local conditions. The entire fill should then be made and compacted uniformly, the object being to provide a sub-base of equal bearing power thruout, for when one part of the foundation of a hard road surface is less apt to settle than another, it is impossible to do away with cracking. A special example may be cited in the case of a hard surfaced road which is to be laid at a greater elevation than the old roadway, where the old roadway was on a considerable fill. As the new roadway will rest upon a fill deeper than the old, the width of the fill at the bottom will be proportionately greater. To obtain a uniform bearing surface, therefore, the material in the old fill should be spread out uniformly in a layer from one side of the new slope to the other and the rest of the fill be placed on top of it. The greatest care is necessary in building any fill of greater depth than two feet, so as to have it in a thoroly compacted state before any hard pavement is laid upon it. If absolutely necessary to place the roadway soon after this fill is made, the material should be placed in layers not

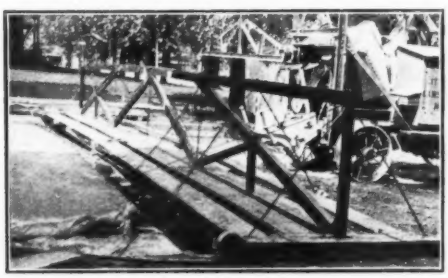
to exceed one foot in thickness, and should be thoroly rolled before succeeding layers are placed. If soil conditions permit, it will be well to settle this fill with water in addition to or instead of rolling. By far the better practice would be to build the fill in the fall of the year previous to that in which the roadway itself will be laid. In this manner many unnecessary cracks can be avoided.

There is a simply made tool which can be used to determine the slope of material in a fill. It consists of three boards—one horizontal, one vertical and one inclined, making an angle with the horizontal piece equal to the required slope of the material. From the horizontal board a plumb-bob is hung and vertically below it on the inclined board a mark is made. This gage is placed with the inclined board along the slope. If the side surface of the fill corresponds to the required slope, the plumb-bob will hang directly over the mark on the inclined board.

It should hardly be necessary to state that it is extremely bad practice to make a fill with frozen materials, yet one or two cases of this kind have come to my attention. When frozen material in a fill thaws it compacts greatly under its own weight and the surface of the fill settles considerably; invariably enough so that no hard surfaced road can stand upon it without cracking.

It sometimes becomes necessary, when grading, to set a stake on one side of the roadway at the same level as that on the other side, when a level is not at hand. This can be very simply accomplished by completely filling a piece of hose with water. By holding one end of the hose so that the water showing in it is just level with the top of the stake of known elevation, and setting the stake on the opposite side of the road at the elevation of the water at that end, you can be sure that the second stake is at the same elevation as the first, the hose acting as a siphon in case the roadway between the stakes is higher than the stakes.

CONCRETE MIXER *which must be supplied with water regularly, and in sufficient quantity.*



The water supply for the construction of a concrete road and pavements is always a problem, if handled economically and satisfactorily The necessity of an adequate supply may be surmised from the fact that the sprinkling of the sub-grade before concrete is laid, the mixing of the concrete and the sprinkling of the finished concrete surface for curing, will require on an average of 13,000 gallons per day, when 500 square yards of concrete pavement are laid. In rainy weather or in the fall of the year the sprinkling may be unnecessary and this amount of water may be materially reduced, but it is unsafe to provide for any smaller amount than 25 to 30 gallons per square yard of concrete laid in the summer months, for an inadequate supply will materially hamper the work, delay the job and increase the contractor's cost.

The volume of water required at the mixer is the same whatever the size of the supply pipe may be. In order to supply the same amount of water the velocity in a small pipe must be greater than in a larger one. But friction increases as the square of the velocity, and therefore the loss of head in a small pipe is much greater than in a larger one. In practice it is rarely found advisable to use less than a 2-inch pipe line to supply water to a concrete road or pavement job, and no connections smaller than 2 inches should be used. Where two sizes of pipe are used, the contractor may have laid his smaller pipe nearest the pump or source of supply before the larger size pipe is secured. He has in one or two instances considered it necessary to place the larger size nearest the supply. This necessitates, of course, that the smaller pipe be carried ahead to the end of the larger pipe, which may be in some instances as much as a mile or two in length. This is unnecessary, as the total friction will be the same whether the larger or the smaller pipe is nearest the supply, tho the smaller pipe may be eliminated sooner from the line if it is laid farther from the source.

It frequently becomes necessary to take a section of pipe from the pipe line to remove an obstruction or for another purpose. For this reason unions which will allow one pipe to turn without turning the one next to it should be placed at distances not to exceed 500 feet apart. Otherwise the entire pipe line must be turned to remove one section, necessitating the use of unreasonable force. T's and taps should be placed in the line not farther apart than twice the length of hose which will be used to connect the water pipe with the mixer. This hose should be at least one inch in size to reduce friction and should preferably be

LAYING CURB AND GUTTER *with water supply to concrete mixer furnished in barrels, quantity required being much less than for pavement.*

short for the same reason, so that it will be well to space the T's and taps not farther than 200 feet apart. Pipe for the water line should be procured in as great lengths as can be economically handled, to lessen the labor of connecting.

When the water is taken from a poor or other natural source, the intake should be protected so that sticks and other foreign matter will not be drawn into the pump and pipe line, where they will cause trouble. When the water supply is taken from a city main it will sometimes be advisable to use a booster pump to obtain a sufficient head for the requirements of the job. In many cases it is possible, when constructing pavements in cities or towns, to connect directly by means of a suitable hose to water hydrants. However, it will be found more economical in a great many cases to be provided with a line of pipe, in order to insure at all times the proper delivery and amount of water required to carry on the work satisfactorily.

Some sort of relief valve must be used in the pipe line so as to prevent the breaking of the pipe or the blowing out of the cylinder head in the pump when it is running but no water is being used. Spring relief valves have been used with success, but a simple arrangement may be used to take their place. At one of the T's previously placed in the pipe line near the mixer, insert one or more lengths of pipe vertically upward. The top end of this pipe will be open and this arrangement will act as a relief valve. If the outflow of water at the mixer is stopped, the pump, instead of exerting pressure against the water confined in the pipe, can raise the height of water in this improvised standpipe and any excess may be allowed to flow thru the upper open end of pipe. This arrangement acts as a relief valve and also assists in procuring a uniform pressure of water at the mixer at all times. This is always desirable and materially helps in obtaining a uniform consistency of concrete delivered by the mixer. This standpipe should be moved frequently so as to be always close to the mixer.

Like all other things, the pipe line will expand and contract with changes in temperature, and unless some provision is made for this expansion and contraction, rupture is apt to occur. For this reason, expansion joints of some kind must be placed in the pipe, preferably at distances not to exceed 2,000 feet. The copper expansion joint is a standard fitting and is often used for this purpose, or a satisfactory expansion joint may be formed by three sets of fittings, consisting of two elbows and a nipple, so placed as to make a "V" in the pipe line. Another satisfactory method is to offset the end of one pipe from the other slightly—say a distance of six inches. These two ends should then be connected with a rubber hose. Connections of this hose with the pipe must be tightly made in order to prevent leaks, and the hose should be of a size at least equal to that of the pipe to

reduce friction, which will be naturally greater where the water is forced thru any bend. Sufficient hose should be used to provide for a movement in the pipe of six inches.

The character of the sub-grade for roads or pavements is sometimes such that sprinkling immediately before placing the concrete results in a muddiness which is detrimental to the work. At the same time, if concrete is placed upon such a sub-grade without sprinkling, the thin mortar will be withdrawn from the concrete and thus prevent its hardening or weaken it. Therefore, it may sometimes be necessary thoroly to sprinkle the sub-grade before the aggregates are placed upon it, so that it will be moist but not muddy when concrete is deposited. Necessity for this early sprinkling can only be determined by an investigation and possible experiments with the particular sub-grade in question.

One of the things which has required the greatest attention in the past is the water supply to the drum of the mixer, so as to obtain a uniform consistency of the concrete. No method should be used which does not automatically supply each batch of materials with the proper amount of water. This makes the use of a measuring device for water, which is positive and quickly adjustable, a necessity. Contractors who are considering the purchase of a mixer, or engineers who are passing upon a mixer to be used upon concrete road work under their supervision, should thoroly investigate this most important part of the equipment—the automatic measuring tank for water.

One of the most difficult things to provide for in specifications is a thoro mixing, because of the different shapes and positions of the mixing drum and blades, as well as the speeds at which the drums revolve on the different makes of mixers. The only satisfactory way to write a specification that will cover all types of mixers is to specify two minimums; one the minimum number of revolutions per minute and the other the minimum time of mixing a batch. A recent device for automatically recording the number of revolutions per batch was on exhibition at the sixth annual good road show, held in Chicago during December, 1914. An indicator was placed on the side of the mixer which could be set to the specified number of revolutions. When the unmixed materials were placed in the drum, this indicator automatically recorded the revolutions of the mixer and at the proper number a bell would ring, indicating to the man at the discharge end that the batch was ready to be removed from the drum. This device is a great step forward in the proper mixing of concrete, for, by determining the r.p.m. of the drum, setting the indicator properly and following the signal given by it, thoro mixing is insured.

The Utilization of Short-Term Convicts for Highway Work in Georgia.

From a Paper by James Leland Stanford before the American Association for the Advancement of Science.

To secure accurate data a questionaire was submitted to persons actually engaged in working misdemeanants on the roads in every county in Georgia. The results obtained are presented in a condensed form in this preliminary report. They give the viewpoint of citizens and officials in Georgia and, being uncolored by outside influence, are of great value.

The State Prison Commission reports that practically all of the misdemeanant and felony convicts, with the exception of the women and those in poor health, are employed in some phase of highway work, 2,441 misdemeanant and 2,740 felony convicts being worked by 124 counties during 1914.

Cost of Equipment for Road Gang.

Camp Equipment.	One Unit.	Two Units.	Four Units.	Six Units.
1. Winter barracks, including guard room	$140	$200	$240	$300
2. Cook room	25	25	25	25
3. Large range, cooking utensils and dishes	125	125	130	150
4. Hospital and furnishings	50	50	75	75
5. Tents for summer camps	50	70	140	200
6. Stable sheds	60	75	125	170
7. Bath house, equipped to wash clothes	25	25	30	40
8. Commissary tent and fixtures	25	30	35	40
	$500	$600	$800	$1,000

Each unit is composed of one guard and fifteen convicts.

Comparison of Increased Cost of Dividing Gangs.

Camp Equipment.	One.	Two.	Four.	Six.
Cost of separate 1-unit gangs	$500	$1,000	$2,000	$3,000
Cost of separate 2-unit gangs	600	1,200	2,400	3,600
Cost of separate 4-unit gangs	800	1,600	3,200	4,800
Cost of separate 6-unit gangs	1,000	2,000	4,000	6,000

Road Machinery and Road Working Equipment

For a 2-unit gang, earth and sand clay construction:

1.	Large 6-horse grader	$255.00
2.	Two-horse grader	110.00
3.	Large rock or rooter plow	35.00
4.	Rock plow	20.00
5.	Five drag scrapes	36.00
6.	Four wheel scrapes	240.00
7.	Four 2-horse wagons	260.00
8.	Ten large mules	2,250.00
9.	Five sets of double harness	100.00
10.	Hammers, shovels, picks and axes	74.00
	Total	$3,350.00

Size of a Road Gang Under Ordinary Conditions.

Regardless of the kind of work undertaken by a convict gang the annual interest on the first cost and depreciation of the equipment and the annual expense of maintaining the convicts must be considered. The economical solution is to so adjust the size of road gang as to render the sum of these factors a mimimum.

Cost of Maintenance Per Convict Per Day.

	One Unit.	Two Units.	Four Units.	Six Units.
1 Physician	0.111	0.055	0.027	0.019
1 Warden	0.132	0.066	0.066	0.022
1 Day guard, per unit	0.066	0.066	0.066	0.066
1 Night guard, per camp	0.066	0.033	0.016	0.011
Food	0.250A	0.230B	0.204C	0.168D
Clothing	0.106	0.100	0.095	0.091
Depreciation	0.075	0.028	0.025	0.021
Interest on first cost of all kinds of equipment	0.058	0.022	0.020	0.016
Total cost per day	0.865	0.600	0.519	0.414
Actual practice plus interest	0.850E	0.559B	0.446C	0.395E

Based on salaries for month: physician $50.00, warden $60.00, each guard $30.00, rate of interest, 6 per cent.

(A) F. F. Hill, Homer, Ga.
(B) J. C. Redman, Butts Co.
(C) E. H. Myres, Ware Co.
(D) V. O. Morgan, DeKalb Co.
(E) Average of several similar reports.

According to reports received and actual experience, which may be said to have passed the experimental stage, a guard can most economically and advantageously handle fifteen men. Fifteen men per guard under ordinary local conditions in the Southern Eastern states has, therefore been chosen as a unit. And it is suggested to the engineer, who is planning a county gang, to make the gang some multiple of fifteen, if he would secure the greatest efficiency per guard and the greatest efficiency per gang. The size of a gang varies in numbers according to the wealth and population of the county, as each county works its own misdemeanants. In exceptional instances only should a road gang be less than two units or thirty men, as the expense per man has been found to increase rapidly when the number is smaller.

The number of units composing a gang should be proportionately determined by such factors as the expense per man; mileage of roads to be constructed and repaired; the character of the work to be done; the class of men in the gang; and the equipment provided.

One engineer reports that in heavy cuts and fills gangs work efficiently up to seven units. For ordinary construction work on county roads, some distance from a base of supplies, experience has proved it more economical to divide a gang when it exceeds appreciably six units.

The expense per man both as to food and guarding at night increases rapidly as the number of men in a gang falls below thirty and decreases just as rapidly as the gang increases by units up to a certain limit. One night guard can handle a camp of ninety convicts quite easily, since the day guards sleep nearby and are ready to give him assistance at anytime. Moreover, men who work on the roads all day hardly need a guard at night. When a four-unit camp is divided into two camps of two units each, an extra night guard and an additional warden must be employed, since the law requires a warden to each camp.

The guards act as road foremen, hence the expense of employing foremen is obviated and balanced by guard hire. The guards should be hired at a stipulated amount and their wages gradually raised as they become more efficient foremen.

In a great many instances it has been found economical to use certain mechanical appliances as labor-saving devices. Mules are generally used for traction in the construction of sand-clay roads, because they can be utilized in places which would make other forms of motive power impracticable.

As yet very little evidence has been presented as to the economic use of mules for road work, and a policy will merely be outlined, which may be considerably modified before a conclusion is reached in the matter. Not only the use of mules, but other forms of traction will each be considered in the final report on this subject. It is evident that the cost of hauling on the ten-mile basis bears a fixed relation to the cost of running a convict camp economically.

The efficiency of a gang in constructing sand-clay roads depends upon the number of mules per gang; within certain limits, "one mule per man is best usage" and secures the greatest amount of efficiency per gang. The mules are usually worked in teams and are hitched to the various appliances used in road work. A great deal of hard labor and valuable time is saved thereby.

When the number of mules drops appreciably below half the number of convicts composing a gang, the efficiency of the gang will become so low that convict labor ceases to be economical and the county will lose money on the job.

When the number of mules appreciably exceeds the number of convicts composing the gang, the number of trusties and the mules operating the machines will be exhausted. It is not a good policy to hire free labor to operate the machines, because of the increased expense and the likelihood of friction with the convicts.

Charleroi Paving Bonds Sold

Twenty-five thousand dollars worth of the $75,000 issue of bonds, authorized at the recent election in Charleroi, Pa., have been sold by Charleroi council to the Holmes-Wardrope Company, of New York City. The bonds are to bear 4½ per cent. and are to mature in thirty years. Together with the selling of the $25,000 bonds, an option was given on the remaining $50,000, to hold until April of this year, at the same figure.

Third street will be the first street given attention. The boro engineering corps is requested by the council to prepare a grade and to arrange all preliminaries for the paving of the street during the winter, so that the contract can be awarded and the work of paving actually started at the earliest possible moment next spring.

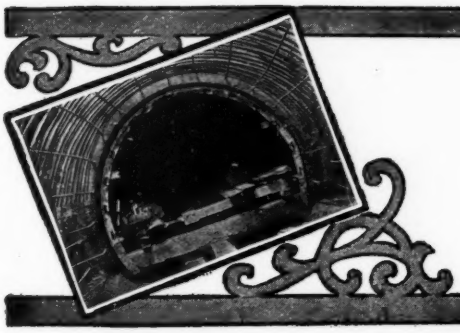
This sale shows that there is full confidence in municipal bonds and that there is money ready to invest in long-time municipal bonds at reasonable rates.

The Boro of Charleroi is enabled by this sale to take advantage of the present prices for materials and thus to obtain lower figures on contracts let at this time than will be available later in the year. The only exercise of judgment required of the contractor in bidding at this time is as to the future price of labor.

Increased Popularity of Municipal Bonds

One of the safest and wisest forms of investment today is that of municipal bonds. The average investor is probably less familiar with this class of securities than with corporation bonds, because in the past the relatively smaller income obtainable on them has led to a broader investigation of, and a more popular investment in, those securities paying the higher rate of interest. Their greater safety, however, has never been disputed, but been amply confirmed by the higher price levels which they have always enjoyed.

In recent years increasing attention has been given to this form of security by private investors, whereas formerly the markets for such bonds has beve been principally confined to eavings banks, insurance companies and trust estates. The explanation for this was in many instances individual prejudice, and, also, as previously stated, because the rate of income had been less than that which it was possible to obtain from corporation bonds. In contrast with the present timidity about purchases of corporation securities there is a conspicuous feeling of confidence toward municipal bonds. About a year ago marked the beginning of a new and favorable sentiment toward them, occasioned principally by the passing of the income tax provision in the new tariff law. This law, exempting municipals from the income tax, focused the attention of investors upon the merits of municipal securities, and has resulted, not only in a broader market for them, but many holders of corporation stocks and bonds have been disposing of some part of those holdings in favor of public, tax-exempt bonds.



SANITATION

Inoffensive Sewage Disposal

By Rudolph Hering before Section D of the American Association for the Advancement of Science.

SEWAGE is dirty water and contains very roughly one part of dead organic matter and one part of mineral matter to between one thousand and five thousand parts of water. It is only the organic matter which concerns us here, some of which is unstable, breaks down quickly and may putrefy within a day, such as certain animal and vegetable liquids, and some is stable and decomposes very slowly, such as hair, wood fiber, epidermis, cartilage and the like. The unstable matter alone usually causes all the nuisance arising from sewage. It has but a slight resistance to decomposition. It first absorbs oxygen with avidity to form more stable compounds; these have no offensive odor of themselves nor do they produce gases with foul odors. Then, when the conditions have become such that oxygen for absorption is no longer available in the medium holding the unstable matter, other chemical processes become active, producing chiefly hydrogen compounds. Among the latter we have those which produce foul smelling gases and others which do not.

In view of these facts and in order to prevent offensive consequences, the practical engineer is obliged to place the sewage from first to last under conditions that permit of its being collected and carried quickly and completely from the points of origin to those of final disposal, and delivered at the latter points before the available oxygen in the sewage water can be exhausted. He is also obliged to provide means to facilitate decomposition by contact with oxygen, so far as practicable, and in its absence by such combinations of hydrogen as will produce no offensive odors.

All of the processes of sewage decomposition are accomplished chiefly by the presence of certain bacteria, which in their activity produce gases, some of which are offensive and some are not. We are here concerned only with those ways and means which will avoid the evolution of offensive gases.

Let us first consider the works for collection and delivery of the sewage with respect to achieving these desired results.

Our wash and bath rooms, toilets, kitchens, laundries, etc., are now supplied with fixtures in such a manner that offensiveness can be entirely excluded. This is done simply by giving them forms and surfaces upon which the dirty water can flow away quickly, no solid particles remain on the surfaces and a final flushing with clean water will restore the receptacles to their condition before use.

¶ VENTILATION *of house connections and free and rapid flow of sewage in them are essentials.*

The pipes carrying into the sewers the sewage thus generated should likewise carry it away quickly and completely. The means for accomplishing this are, first, smooth and evenly curved and jointed pipes, and, secondly, good currents of air circulation. The former prevents catching, retention and consequent putrefaction of solid particles, the latter tends to clean up the exposed surfaces which are otherwise usually covered with slimy growths. This air circulation is automatically established by providing openings to the sewer from the street surfaces, and openings to the house pipes above the roofs of buildings.

There was formerly strong opposition, particularly in England, to street sewer air passing up thru the house pipes to the roof. It was feared that street sewer air might enter rooms thru imperfect pipes or thru the fixtures if their traps were not in order. This opposition is still generally maintained. On the European continent and in many American cities,

the ventilation of street sewers thru house pipes has, however, been found very advantageous. The house pipes are kept much cleaner, the slimy coating is largely removed and the escaping air above the roofs is less odorous than when the house pipes are trapped at the bottom against the street sewer. A careful examination made in this country proved that the escaping air from house pipes contains practically no disease germs or other bacteria.

After the house sewage enters the street sewers it should be kept flowing without any interruption. This result is readily attained if the sewers are designed and built with reference to this end. The surfaces again should be smooth. Vitrified clay pipes, used for small sewers more than any other kind in this country, have the smoothest surfaces. Yet the inevitable projections at the joints, due to the manufacture of the pipes, reduce this advantage to some extent. In practice, therefore, the pipes are laid so that there is no projection at the bottom, upon which the sewage flows, and which would retain solid matter, but all of the projections are at the top. Cement pipes can be made almost as smooth as vitrified pipe and have no projection at the joints. Concrete sewers have the same latter characteristics. Brick sewers furnish the roughest surface, even if the joints are carefully made and the bricks are of the best. With good flushing and brushing down at proper intervals even brick sewers may be kept in such a condition as to entirely prevent offensive odors from generating therein.

Other important elements as regards odor production are the junctions of several sewers. They must always be made so that the sections above them are gradually and not suddenly merged into the sections below them, which construction prevents eddies and deposits resulting in putrefaction and odors.

¶ VENTILATION *of sewers themselves and systematic flushing are also essential.*

Finally, to preserve an inoffensive condition in sewers, we must establish within them a systematic ventilation and flushing.

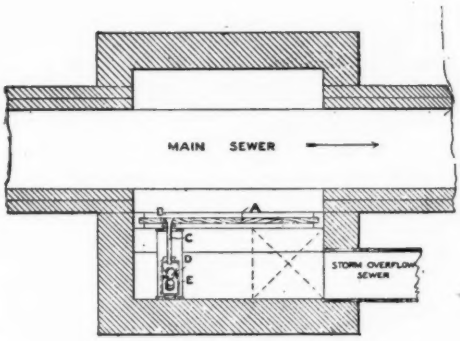
Ventilation is generally secured by the natural differences of temperature existing in various parts of the sewer system. It has been found best to let the air circulation take care of itself, by providing the necessary openings, ample in size, for the air to enter and others for it to escape. It happens sometimes on cold days that the air circulation is in the opposite direction to that on hot days. This reversal of current is not objectionable if the sewers have no foul deposits in them and if the ventilation has at all times been free and ample. Artificial ventilation was thought necessary in former times and numerous contrivances were introduced. Today, after long experience, it is known, when sewers are properly designed and built, and properly cleaned and flushed, that natural ventilation is entirely sufficient and satisfactory.

Flushing is another important requirement for the sewers to prevent offensive odors in them. Above ground, within our houses and on our bodies, we use ample amounts of water for cleansing purposes. Below ground in sewers, ample flushing is equally and even more necessary, due to the relatively greater concentration of unstable decomposing organic matter. Unfortunately in our country the finishing of sewers has not been given as much attention as is desirable. In almost all European countries, both small and large sewers are flushed frequently, varying from several times a week to once in one or two months. The results of this frequent flushing are very satisfactory and the money is willingly appropriated.

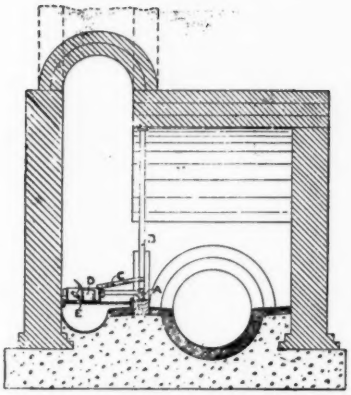
In our country, particularly in smaller cities, we have extensively introduced automatic flush tanks at the heads of all pipe sewers. While these tanks keep the upper ends of the sewers clean and free from deposit in a very satisfactory manner, they do not keep the larger sewers lower down the line free from deposits and odors. In this respect our sewer systems could be greatly improved and the odors therefrom materially diminished.

¶ PUMPING *for a low lift,* AERATION, *and* SCREENING *at various points in the system are suggested as methods of reducing nuisance from sewage at end of long slow flow.*

When collecting sewers are long and the distance to the outfall is great, which fact is generally associated with flat grades and slow velocities, we have almost always some putrefaction and offensive odors arising near the lower end. During the long run the oxygen has become exhausted and hydrogen compounds, notably sulphureted hydrogen, are developed. The obviation of this condition may be secured by emphasizing several remedies above mentioned. For instance, the surface of the sewer should be made especially smooth, means might be employed for a more thoro flushing than would otherwise be necessary and the grades and sewage velocities might be improved by the introduction of a low lift or booster pumping plant.



—PLAN—



— SECTION —

DESIGN *for storm overflow sewer and setting of apparatus for taking sample of sewage or storm water at any height for which it may be set.*

Still another expedient might be practicable, by replenishing thru artificial aeration the dissolved air, from which the oxygen has been exhausted and putrefaction has been initiated. Experiments have been made recently both in England and America to accomplish this purpose and have resulted in more or less success. Where it is possible to force air into a sewage pumping main, under a pressure of at least one atmosphere, good results have been obtained with the sewage after its discharge into a sewer. Distributing air into the sewage within the flowing section and under ordinary pressure seems as yet to have given only moderately good results.

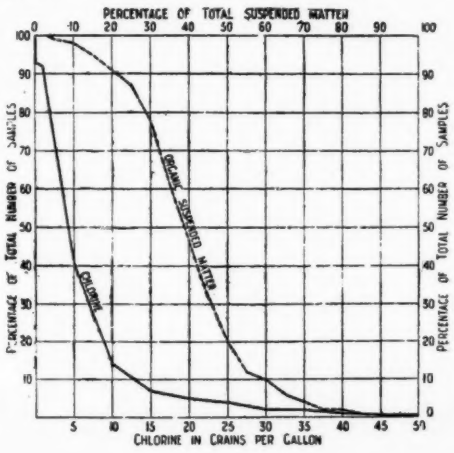
There is one more means by which the fouling of sewage on a long run can be reduced and incidentally also the expense of the final sewage treatment. When we consider that but very little of the organic matter which is discharged into sewers at the house is dissolved, and that about one-half of it is dissolved when the sewage reached the outfall of an average city, and also that dissolved matter withdraws oxygen from the water more quickly than the solid matter, we must conclude that a removal of solid matter by fine screening or short-time deposition higher up the sewer, before much of it is dissolved, would be of benefit. A number of small settling tanks near the beginning of the main sewers might, for instance, not only prevent foul odors near the lower districts, but prevent also the necessity and expense of works for oxidizing the amount of dissolved organic matter which is thus eliminated.

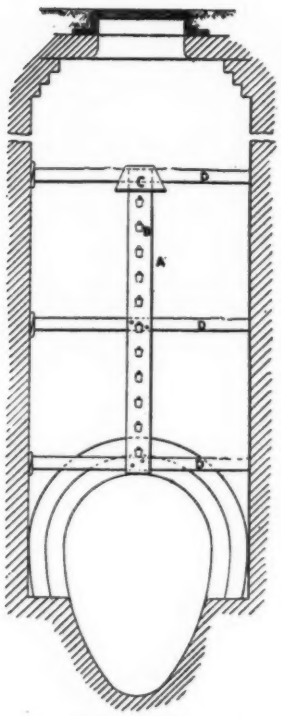
Automatic Sampling and Measurement of Sewage

T. DeCourcey Meade, city surveyor of Manchester, England, has used with much success the apparatus which is described as follows:

Altho the existing sewers are relieved by storm overflows, they work under a head of water in times of storm. Many local and tributary sewers also become surcharged during periods of heavy rain, chiefly owing to the insufficiency of the

DIAGRAM *showing pretrescibility of storm water overflow in sewer. The full line shows the percentage of the total number of samples containing the various amounts of chlorine, given on the lower horizontal scale. The broken line makes like showing for total suspended matter, given on upper horizontal scale.*


PERCENTAGE OF TOTAL SUSPENDED MATTER
0 10 20 30 40 50 60 70 80 90 100
100 90 80 70 60 50 40 30 20 10 0
PERCENTAGE OF TOTAL NUMBER OF SAMPLES
ORGANIC SUSPENDED MATTER
CHLORINE
5 10 15 20 25 30 35 40 45 50
CHLORINE IN GRAINS PER GALLON



SMALL TIN CANS B *on the board A by filling as water rises show height to which sewage rises in manhole, thus giving the maximum rate of flow of sewage between observations.*

main sewers into which they discharge.

In Manchester there are upwards of 200 storm overflows, and no two of these are exactly similar in construction. As the main drainage work proceeded and the old seyers were exposed, an accurate survey was made and detail drawings prepared to meet the conditions found in each case.

It was necessary to ascertain the character of the diluted sewage passing over the sill of each overflow at the beginning of a storm. In a town where there are a number of overflows it is obviously impossible to take the samples by hand. A simple and cheap arrangement for securing these samples was therefore devised and successfully used for several years in Manchester.

The figures 1 and 2 show a plan and section of a typical storm overflow chamber for small sewers, with the automatic sampler in position. The arrangement consists of—

An overflow sill (A), an upright wooden post (B), a leaden gutter or channel (C), leading the storm water to the sampling apparatus, which consists of a receiver (D), fitted with a heavily weighted lid; from the back of the latter a wire projects to which is attached a cork; the whole apparatus is placed in a strong wooden box or cistern (E).

The receiver (D) is closely covered with an airtight joint when the lid falls. The cost of this sampling appliance, fixed complete, is under a sovereign ($5).

The following diagram (Fig. 3) shows the putrescibility of the samples taken at the sill level of the storm overflows in the city, arranged in order of grains of chlorine per gallon, this being considered an index of the putrescibility. The percentage of organic matter in the total suspended matter is also indicated on the diagram. It will be observed that only a comparatively small percentage of the samples taken have high chlorine figures or a high percentage of organic matter.

For the purpose of obtaining accurate particulars of flood levels in sewers, the arrangement shown by Fig. 4 has been successfully employed in Manchester.

The device consists of a board (A) placed vertically in the manhole shaft to support a number of small tins (B) placed at regular intervals. These vessels fill as the water rises and record the height to which the sewers have been surcharged. The tins are protected from roof drippings by the hood (C).

Concrete Pile Standards

A booklet just published by Hunley Abbott, 11 Pine street, New York, entitled "Concrete Pile Standards," is a book of drawings, specifications and other data prepared for the assistance and convenience of engineers, architects and designers who have to prepare specifications and plans for concrete pile foundations. It touches on practically every step in the design of such foundations and much time and expense may be saved by the use of these standards. The price of the book is 50 cents and it contains:

1. Standard details of reinforced concrete pile caps, full explanation of their design and large scale dimensioned drawings of all the standard and many special cases with estimated quantities and bills of material.
2. Standard specifications for all types of concrete piles.
3. Concrete vs. wooden piles; a comparison of costs under various soil conditions.
4. The theory of pile support, with actual values for friction and bearing quoted from recognized authorities.
5. Detailed description and drawing showing the method of testing a concrete pile.

CONCRETE

Testing and Handling of Aggregates for Concrete

From a paper by H. S. Mattimore, First Assistant Engineer, New York State Highway Commission, before the Association of American Portland Cement Manufacturers.

At the invitation of your association I have been directed by the chief engineer of the New York State Highway Commission to discuss the methods of testing concrete aggregates with special regard to those used in concrete pavements. We feel as though we have succeeded in securing a concrete of an excellent quality on our highways principally by the selection of good materials and a first-class quality of engineering inspection.

It is absolutely essential that a good quality of cement should be used in concrete, but we should constantly keep in mind that cement, altho the important ingredient in concrete, is only one of several ingredients used in mixing this product, and in order to secure a first-class concrete the other ingredients must also be of a good quality.

To insure a fine aggregate of high grade our department has drawn up the following definite specifications: "Fine aggregate shall consist of sand, free from organic matter; that which shows a coating of the grains shall not be used until satisfactorily washed." No. 1 sand for use in concrete pavement shall be of the following gradation: 100 per cent. shall pass a ¼-inch screen; not more than 20 per cent. shall pass a No. 50 sieve and not more than 6 per cent shall pass a No. 100 sieve." "Sand may be rejected for this class if it contains more than 5 per cent. of loam and silt." "Mortar in the proportion of one part of cement to three parts of the sand to be tested shall develop a compressive strength at least equal to the strength of a similar mortar of the same age composed of the same cement and standard Ottawa sand."

"Screenings when approved in writing by the chief engineer may be substituted for a portion of No. 1, 2 and 3 sand under the following conditions: The screenings shall be free from dust coating and other dirt, 100 per cent. shall pass a ¼-inch screen and not more than 6 per cent. shall pass a No. 100 sieve." The compressive strength of a mortar in which the screenings and sand are in the proportions intended for use, shall be at least equal to the standard strength obtained with sand of the given class."

You will notice from the specifications quoted above that the only allowable use for stone screenings as fine aggregate is when mixed with a proportion of sand. We have had some field tests made on using all screenings for fine aggregate and these have shown such doubtful results that it was not thought advisable to replace all of the sand by screenings. It is possible to get good concrete with screenings in laboratory test, but when tried on a large scale in the field it is extremely difficult to get a uniform well-graded material. The proper proportion of screenings from the hard variety of stone will improve a fine-grained sand, but the high costs for careful inspection and proper mixing is likely to make their use prohibitive, except in instances where a good quality of sand is very expensive.

The specification for stone as coarse aggregate in concrete requires that samples shall be tested before being used in the work. It must be free from dirt and coating of any kind. As a tentative specification we require that stone for use in concrete pavement shall show a "French coefficient" of at least nine when tested in the standard abrasion test for stone.

Some few miles of concrete pavement have been built with gravel used as coarse aggregate. These were in sections where a very high grade was available. Such material was all tested and had to meet the equirements of being composed of all sound, durable stone, and to be absolutely clean and free from coating. We have found the gravel banks in a large part of the state to run so non-uniform that it was not thought advisable to use this product in concrete pavements except in limited areas where we have assured our-

selves from past experiences that a uniform product can be obtained.

An endeavor is made to use local materials as far as possible in all our work, and the above specifications were written after a careful study of several hundred sand tests from widely scattered portions of the State. Availability was considered with the idea of quality paramount.

During the routine of the physical laboratory within the past year the work included the examination and testing of samples representing 1,080,580 barrels of cement, 909 samples of sand and 857 samples of stone. The cements were tested according to the standard methods of the American Society for Testing Materials, with which no doubt you are all familiar. There being no standard tests for sands, the following is a brief outline of the tests and methods employed in our laboratory:

Gradation—1,000 grams of the sand to be tested, after a careful weighing, is screened through the ¼-inch, No. 6, No. 20, No. 50, No. 100 and No. 200 mesh sieves. After weighing the residue on these sieves, the proportions passing are readily computed. We found from past experiences that these are the essential sieves for an intelligent judgment of the gradation.

Voids.—For the determination of the voids, the sand is placed and loosely compacted in a graduated cylinder. This latter has a hole drilled in the bottom in which a tube is connected leading from a burette filled with water. This apparatus is placed and worked so that gravity causes the water to rise slowly thru the sand, forcing the air ahead. By reading from the burette the amount of water which has flowed out, the voids can be computed with a practical degree of accuracy. This method of allowing the water to flow in from the bottom rather than from the top of the sand eliminates the forming of air pockets, which are extremely difficult to avoid by the latter method.

Loam.—For the determination of the amount of loam, a portion of the sand sample is placed in a graduated cylinder and well covered with water. This is thoroly agitated and then allowed to settle from ten to twenty-four hours. The loam and silt, which readily separate from the sand, are deposited on top of the sand and the proportion can easily be computed. This method of loam determination by volume, we believe, is as refined a determination as necessary to fit all practical requirements. It also allows an easy method of checking in the field.

Compression Tests.—The majority of our compression tests are made on 3-inch cubes mixed 1 part of cement to 3 parts of the sand. These are stored in moist air and broken in fourteen days; 4 cubes are made from each sand, 2 from the natural product and 2 from the washed. For a comparison of the compression, 4 cubes of the same size mixed with standard Ottawa sand and the same cement are made, stored and broken under the same condition and at the same age. The cement used for this purpose is a blend mixed in the laboratory from cements which show similar characteristics under tests. The cement and sand in the cubes are proportioned by volume rather than weight to avoid the variation of the latter in sands of different character. The cement, altho measured by volume, is carefully checked by weight to eliminate different degrees of compactness in measuring.

At present time we are running a series of sand compressions on both two and three-inch cubes for the ultimate purpose of using the smaller size cube. These latter will be made up in lots of four, two of which will be broken at seven days and two at twenty-eight days. This in many cases will decrease the time necessary for a sand test and also enable us to observe the relations of the strengths at the different ages.

Of our tests we consider the compression strength of the sand in mortar of major importance, but as this depends more or less on other determinations, especially gradation and percent of loam, silt or organic matter, it is advisable to run a full test in order to properly judge the material.

Occasionally sands are tested for tensile strength, but our experience on the relation between tension and compression strengths of sand mortars has verified the results obtained by other investigators in the fact that this relationship is so nonuniform that it is absolutely unreliable, and as we build plain concrete to withstand compression rather than tension, we should test it from that standpoint.

During the course of construction, the concrete highways are under constant supervision of competent engineers, their duties not only include ordinary highway way engineering work, but they are required to closely inspect all concrete aggregates. This especially refers to sand and gravel supplies, and when such material shows any great change in character, this being determined by field tests for gradation and loam, such conditions are immediately reported to their superior engineer, who takes steps to rectify them and compel the contractor to secure suitable materials.

One of the important checks instituted within the past year on our concrete work was in the testing of the finished product. Engineers in charge of concrete work are required to make 6-inch cubes from the

mixed concrete as deposited in the work. Two cubes are taken from every 500 cubic yards of concrete laid. This, in the case of a concrete highway sixteen feet wide and of our standard thickness represents about 1,700 linear feet of roadway. These specimens are stored in moist sand near the highway for twenty-one days, at which time they are sent to the laboratory, where at twenty-eight days they are tested for compressive strength. The engineers on the highways are notified of the results of such tests and this seems to have promoted a friendly rivalry between them to endeavor to obtain the best possible concrete. This pride in accomplishment certainly tends toward obtaining desired results. The chiefs of the department do all in their power to build an excellent type of highway, but in the end much depends on the engineers directly in charge.

By means of the above described tests I know we obtain a good quality of aggregates and the final tests on the field cubes give us an excellent check on both material and workmanship, but we also realize that the using of concrete for highway surfacing introduces the factor of making a concrete to resist impact and abrasion. This at present is well taken care of by using a rich mixture, but at the same time we are studying both concrete and mortars from this standpoint and hope in the near future to be able to devise some method of testing the abrasive and impact resistance of various aggregates.

The curves in the accompanying diagram are self-explanatory. Their main value is that they are the results of field tests, thus giving a good illustration of the concrete obtained in actual practice. I believe this is a good fair comparison of stone and gravel concrete, as both of these aggregates were of high grade, particular attention being paid to obtain a clean, uniform product passing all requirements for this class of concrete.

You will notice the material made with screenings, altho showing a fair compression strength, is much below that obtained with a good sand. These latter cubes were made from concrete placed on highways previous to the adoption of the specifications quoted above.

Expansion Joint for Concrete Paving

The accompanying photograph shows the method of placing the Trus-Con armor plates for protecting joints in concrete paving. The form of the plate, with the double hooks for tying the plate back into the concrete, can be seen clearly. The picture was taken on McKinley Place, Grosse Pointe, Mich., opposite the Country Club, running thru a district of expensive suburban homes.

Development in Culvert Construction

By Edward J. Whalen, Syracuse, N. Y.

One of the essential features of a modern road is the proper drainage. Usually ditches run along the sides or on one side of a road, and at certain points in order to keep the water level down, the water is carried from one side of the road to the other. These ditches should be of good size, and be able to take care of all ordinary rainstorms. They should be free from obstructions so as not to block up the ditch, causing the water to rise too high. If the water stands in the ditch it soaks into the base of the road. The result is a big mudhole in the road, the top settles down, and the people who use the road are not very much in favor of riding over it in an automobile. Sometimes, you will find water going over the road, caused by a culvert being too small.

What is a culvert? It is a covered channel, to carry water from one side of the road to the other.

Years ago, culverts were made from wood, as that was the handiest material at that time. However, it is not used much any more. It was very expensive, and dangerous, as it decayed quickly, and many lawsuits were brought against townships on account of horses, cattle, etc., being injured, or legs broken by stepping into holes. Traction engines usually dropped through every one they came to. It is very seldom that a wooden culvert is found nowadays. They are and should be a thing of the past.

As time went on, manufacturers brought forward the drain tile to be used in place of a culvert. They were taken hold of readily, and came into general use in many localities, and were of great benefit to their manufacturers. In fact, I know of a culvert made of drain tile which was replaced one a year for several years. However, the drain tile has the disadvantage of causing high water levels, and insufficient capacity, owing to their being round. The frosts and other causes lead to their disintegration, and as a result of heavy traffic they soon break down.

Later on, commercially minded people began bringing out pipe, sheet iron tubes, etc., for culvert use.

States which have modern, efficient, highway organizations, have prohibited their use, and the use of inefficient, poor quality pipes is not encouraged anywhere. They lack sufficient capacity on account of their being round, and cause high water levels. Sometime these pipes are galvanized and are used in primitive road building today. That is, where they are experimenting, not profiting by the mistakes of others. They are hardly ever provided with head walls, which are very essential. A culvert without a head wall is like a tack without a head. You can put it in, but it is not much good. Such a substitute for a culvert seldom if ever, was as long as the width of the road. The water wore away the sides of the road, and if you drove along the road it was necessary to keep in the middle of the road or get wrecked. In a few months time the small pipes became clogged and filled up, and perhaps their location was lost.

Now, as we understand it, the primary object in putting in a culvert is to carry the water from one side of the road to the other, a culvert being an artificial archway under the road. The first idea should be to have a permanent and a durable culvert, with ample capacity, and the culvert should be wide enough to take care of flood conditions, and at normal times to furnish a good pasasge for the water. Especially in the spring, as the surface of the earth road at this time is soft, is easiyl washed away, and should not be forced to flow across the road. We might say, that the road surface should be rounded also.

It would be a better and more economical procedure to build where the head room is limited a concrete culvert which could be a semi-circular nature, with a radius of 12 inches, for example. This would have the same head room as a 12-inch pipe but would have twice the capacity. It is very strange that anyone who uses his head would use a small round pipe in this instance if he wanted to lower the water level and increase the capacity. He simply works against his better judgment. Here again, a great mistake is made, they sometimes use a larger pipe, and raise the surface of the road, resulting in a hump in the road which is rather unpleasant to drive over, unsightly and unnecessary. In some places they call them "thank-youmams," but no one is thankful that they are there.

All this experimental work is absolutely unnecessary. Semi-arch, standard, permanent, beautiful, monolithic concrete culverts are easily, quickly, and readily constructed by using a collapsible steel culvert form, with equipment for building head walls, wing walls, etc., and requires no more head room than the little round pipe. Such a concrete culvert is based on the universal law of efficiency and economy, and has a 300 per cent. lower water level.

New York state has certain standards for her culvert construction, and all these standards have to be adhered to, altho they have flat tops. Still every one knows that an arch gives greater strength, and uses less material, and

gives greater capacity. However, New York state standard structures were designed by the world's greatest engineers. Some of New York state standards are as follows: 24x15 inches, 27x24 inches, 30x24 inches, 54x24 inches, etc. The tendency si to have the culvert long span and low rise. Any of these standards are easily built by a modern, standard, collapsible steel form.

Standardization has been adopted in some states, and should be in all. However, they are only in evidence in states which have diligent highway departments. This custom of letting every highway official do as he wants to results in peculiar developments, which show the lack of engineering judgment.

Concrete in culvert construction is superseding all other materials, the same as it did in sidewalk, curb, gutter, bridge, and road work. It is permanent, and saves huge sums of money every year.

The concrete mixer has been a great help in the work. There are a good many mixers on the market, in all sizes and conditions, and their prices are reasonable. They are labor savers and hence, moneymakers.

However, the mixing of concrete does not end it all. One should have the right kind of a mold or form to pour the concrete into. One that is easily and quickly set up, and can be readily removed. One that is durable, rustproof, and watertight, and can be used for a number of different styles. The remedy is a good, collapsible, steel, culvert form.

Lumber is too expensive. It requires the services of an expert carpenter to build a wooden form, moreover a wooden form cannot be used more than three times, before it is all warped out of shape, and has to be thrown away, as the concrete is wet, and the air is dry, and the result is the form is soon wracked to pieces. Another great trouble is that the cement in solution passes out through the cracks of the wooden form, and the culvert is filled with cracks, resulting in an impoverished culvert, with a short life. Disintegration takes place. Some people blame the concrete or cement, however, it is the fault of the one who permitted the use of the wooden form.

Build your culverts from Boston to San Francisco of concrete over a standardized steel culvert form, and instead of ill-looking culverts, you will have beautiful, standard, monolithic, permanent concrete culverts, which will be monuments to their erectors for all time.

The sizes of culverts should be the same for the same conditions everywhere, and should be as standard as the wagon gage, railroad gage, etc.

Universal Safety Standards

The first volume of the Universal Safety Standards, "Machine Shop and Foundry," by Carl M. Hansen, M. E., chief engineer of the Workmen's Compensation Service Bureau, New York City, M. Am. Soc. M. E., is a handbook of concrete examples of safeguarding and rules for practice in machine shops and foundries.

This is the first one of a series of books which will be issued under the direction of the Workmen's Compensation Service Bureau, in the course of the next two or three years. The titles of the others will be Woodworking, Leather and Shoe, Mercantile and Theaters, Textile and Clothing, Brick Pottery and Glass, Paper, Printing and Allied trades, Electrical, Grain and Flour Milling, Dyeing and Laundry, Mining, Miscellaneous. These books will all be compiled under the direction and with the approval of the Workmen's Compensation Service Bureau. They will all bear the endorsement of the leading compensation and liability insurance companies and these standards will be exclusively used in fixing the rates for workmen's compensation insurance under the Universal Analytic Schedule.

Compensation on laws have made indemnity for accidents compulsory. This indemnity is one of the large items in the cost of production. To reduce the cost of production and effect a saving in operation, accident prevention is one of the most prolific fields. Employers and others interested in safety need authoritative information on the methods of assuring safety which will meet the requirements of the rulings of their insurance companies.

In order to supply this demand, safety must be standardized. The Workmen's Compensation Bureau has seen fit to adopt Universal Safety Standards as its minimum requirements for industrial safety. It makes this approval because the book "Machine Shop and Foundry" (Universal Safety Standards) represents, in its opinion, the ideal condition for which they are constantly striving. These standards were prepared with the aid of some eighty engineers working under Mr. Carl M. Hansen's direction and with the advice of and contributions from the leading industrial organizations in the country.

The book is purely a "How" book on safety as opposed to the usual type of "Why" book. It starts where others stop; viz., where others convince you that safety is necessary, this book shows what is necessary for safety. It describes and specifies conditions and machines and safe means and measures for guarding these conditions and machines.

But it does not stop there. With each

specification it shows a detailed drawing of what the specification means, all of which is the application of the principle of safeguarding. This arrangement makes everything absolutely clear even to the machine operator. Very interesting examples are the treatment of stairways, steam engine guarding and grinding wheel protection.

This system is now being applied in thirteen states and last year twenty thousand plants were merit-rated, having one million two hundred thousand employes and with a payroll of seven hundred million dollars. This produced a saving in premiums in the neighborhood of two million dollars. The cost of installing safety devices in general is made up in the savings on insurance premiums. As part of this system, it has become necessary to standardize safety as a basis for rate deduction, and this volume, "Machine Shop and Foundry" is the result. It is the first time that a comprehensive study of this kind has ever been made.

The volume is attractively bound in limp seal leather, 312 pages, indexed, price, $3.00 net, and is issued by the Universal Safety Standards Publishing Company, 12th and Race Sts., Philadelphia, Pa.

By-Product Coke Oven Gas for Chattanooga

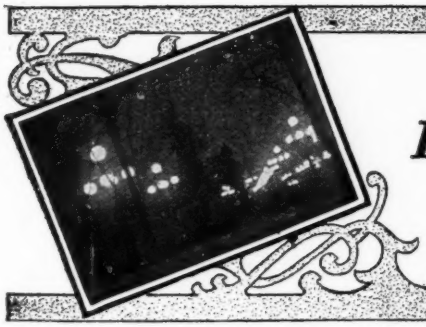
The Chattanooga Gas Co., Chattanooga, Tenn., is making elaborate prepartions to push the sale of gas for manufacturing purposes, incident to their contract with the Chattanooga Gas & Coal Products Co. to buy 200,000 feet of gas daily. The latter concern is now erecting a 12-oven plant, each oven of 16 tons capacity, of the Roberts type. The plant, it is anticipated, will be finished and in operation next spring. When completed, the investment will be between $450,000 and $500,000. The plant is a by-product one, the company itself planning to develop, aside from gas for furnace, foundry and domestic use, coke, tar and sulphate of ammonia. Further than that the coal products company will not go, but is anticipated that other industries will be attracted by the supply of by-products, such as tar, and establish plants for the distillation and conversion of same into commercial forms. Also, there is good reason to believe that the gas, sold at rates fairly competitive with natural gas, will attract manufacturing lines such as pottery and glass, the former not now represented in the Chattanooga district at all, the latter by only one factory.

The by-product plant is located in one of the suburbs of Chattanooga. The company is subsidiary to the Durham Coal and Coke Co., of that city, and will coke coal from the immense coal lands of that company. It will be necessary to lay some four miles of gas mains to pipe the gas from the by-product ovens to the distributing system of the Chattanooga Gas Co. The first order for pipe aggregated 22,000 feet, or an expenditure, it is stated, of about $20,000. The order was placed with the James Supply Co., of Chattanooga.

The distributing company plans an extensive campaign for inducing manufacturers to adopt the use of gas for mechanical purposes instead of coal. To interview manufacturers of various gas machine appliances, General Manager S. E. DeFrese, who is president of the Southern Gas Association, visited Chicago recently in connection with his trip to the National Commercial Gas Association meeting in Minneapolis. On his return, he began the remodelling of the downtown office and exhibit rooms in order to install an exhibit of gas appliances for the special purpose of demonstrating the various uses to which gas can be put in the mechanical arts.

Introduction of by-product ovens at Chattanooga creates a very interesting situation and one which will doubtless be watched keenly by those connected with the gas industry and lines of manufacturing in which gas is used. It should help very patently in the industrial growth of Chattanooga, which is already an important manufacturing center with nearly 300 factories and greater diversity of products (1,137 articles) than any other southern city. The Chattanooga district is one of the principal soft coal producing sections of the country, 20,000 tons being mined daily. The Roberts oven, furnished for the plant at Chattanooga by the American Coal and By-Product Coke Co., Chicago, is the only flueless type on the market. It is claimed to coke coal in a shorter time than other types and also to produce coke suitable for metallurgical purposes from coals which have heretofore been technically known as non-coking.

The Western Gas Construction Co., Fort Wayne, Ind., is furnishing the by-product equipment, which is standard, and of the so-called indirect process for ammonia recovery. Kerr-Murray Co., Chicago, were awarded contract for gas holder; Wallman, Seaver, Morgan & Co., for coke pushing and coal levelling machinery, and lorry cars; R. H. Beaumont & Co., Philadelphia, for coal and coke conveying, screening and grinding machinery; American Refractories Co., Chicago, silica brick. Several Chattanooga firms also participants, such as the Casey Hedges Co. and Converse Bridge Co.



FIRE AND WATER

Locating and Mapping Pipes and Valves in an Old Water Works System

By Carleton E. Davis, Chief of Bureau of Water, Philadelphia, Pa., before Section D, American Association for the Advancement of Science.

FOR the adequate control and effective operation of the distribution system of a municipal water works, the location of pipes and valves should be definitely known, as well as the function performed by such pipes and valves. Data should be recorded in such a way as to be readily understood and interpreted and should be accessible for immediate use, in case of an emergency, by more than one person. The more complex the system, the more important becomes definite and easily used recorded information stored only in the minds of certain individuals.

For one reason or another, too much dependence has been placed upon the personal knowledge of individuals, or, perhaps, a single employe, and too little has been done upon the work of recording facts and data in such shape as to be of use by any person, incidentally extending thereby the usefulness of many persons.

The lack of proper records and plans may be felt in a minor degree as an everyday handicap, but is liable to be particularly emphasized in case of an accident, such as a break in a main pipe. Here the flow of water must be stopped, and the circulation readjusted so as to cause as little annoyance and inconvenience to consumers as possible. This means that a number of valves must be first found, and then operated in such a manner as to produce the desired results, and such work must be done quickly.

Of scarcely secondary importance is the necessity of similar records for service pipe connections from the mains in the streets to the properties of the consumers. Affiliated with these latter records are the data recording the arrangement of water piping inside buildings or private properties, with special reference to unauthorized outlets or connections with a private, and possibly contaminated, water supply for fire or manufacturing purposes.

The situation in Philadelphia may be typical. It is not intended in this paper to give the details of the locating and mapping work that is being done in this city, but to outline briefly the general principles controlling such work.

The original water works of Philadelphia were constructed about 1801. The first cast-iron pipe was laid in 1817, and considerable pipe which was in the ground as early as 1820 or 1830 is still doing service in the distribution system. The present city is an amalgamation of a number of distinct municipalities, some of which had water supplies at the time of incorporation with the larger community. Such water works were joined to the Philadelphia supply and are even now a part of the general system.

As the city of Philadelphia has grown, various water supply projects have been developed, used, outgrown and abandoned in whole or in part. During the last fifteen years the introduction of a filtered water supply has brought about a radical readjustment of the principal supply mains and a realignment of the distribution districts.

Certain general maps and plans are available, invaluable as a basis of a more comprehensive and useful record scheme, and representing a large amount of research in the past, hard work and wise foresight. These particular maps in Philadelphia were compiled by Mr. William Whitby, of the Bureau of Water. They are now being developed and expanded with a view of increasing the amount of detailed information, distributing such information widely thruout the Water Bureau, and putting it in such shape that a larger number of employes can be used to a greater advantage by reason of its existence and accessibility.

The scheme provides certain general features:

1. Data used chiefly for controlling and regulating the amount and pressure of water thruout the system, or in other words, data used in operating the supply.

Under this head are maps defining the limits of the several distinct distribution areas, which maps are accompanied by data showing the sources of supply for each area and a list of valves controlling the supply; likewise general maps showing all large mains, reservoirs and pumping stations, together with detail maps of the piping system and operating valves at the pumping stations, filters and reservoirs.

2. Data used chiefly for repairs and maintenance.

Under this head are maps showing the complete gridiron of distribution pipes on which the locations of all valves and hydrants are indicated. The detail of such maps is expanded by intersection plans showing on a larger scale the situation at each street intersection. Each street intersection is mapped on a separate plan of a size convenient for use in the field.

3. Data used chiefly for the business relations between the consumer and the Bureau of Water.

Under this heading come data relating to service pipe connections, such as the location, depth, size, date of insertion, kind of pipe, etc. These data are listed in a card index and filed by streets and numbers.

The system likewise proposes under this head full plans of all pipes in important establishments which may have a special supply for sprinkler systems or other fire protection. These plans will indicate the relations between pipes carrying city water and private pipes which may carry a possible polluted water from a private source, introduced for the purpose of fire protection or manufacturing. The necessity for the complete severance of these dual supplies can be readily seen.

¶ THE PROGRAM *for locating and mapping existing pipes is laid out, with suggestions of methods for use in special cases.*

Assuming an available force of sufficient size and individual experience and capacity, the work of mapping pipes and valves proceeds normally along three lines:

1. Compilation of existing data wherever and however those data may be listed:

Reports and plans were searched and examined, though of course the chief mine of information was found to be in the memory of old employes. Considerable tact and discriminating judgment were necessary to elicit the information stored in the minds of these old employes and give to such information its true value and assign to it its proper place.

2. An investigation and determination of the present and possible function and use of the several parts of the system.

In investigating the use and possibilities of the present pipes, pitometer corps, equipped with apparatus to measure readily the flow in any pipe, have been used to great advantage.

These pitometer corps serve a twofold ourpose, for, while measuring and studying the flow of water and determining its fluctuation, they at the same time detect leaks and locate points of undue use or waste. Incidental to this study of the flow is the operation of control valves, in the course of which the location of the valves is verified, their condition and character are noted, and other data obtained which form part of the detail location maps.

More or less information is likewise brought to light concerning service pipes, even some unknown ones being unearthed. Various devices are on the market which aid in locating lost service pipes, tho sometimes nothing but digging will bring the desired information.

Governing the rather restricted operations of the pitometer corps is an overhead study of the whole distribution field, including investigation of proposed changes in the major control system.

Like the pitometer corps, which obtains certain incidental facts while working along definite lines for the purpose of obtaining other information, the general repair and maintenance forces are likewise utilized for the same purpose. Without adding noticeably to their labor, they turn in much that is valuable in the shape of permanent records. Each foreman in charge of a repair or maintenance crew is furnished with a pad of paper showing the lines of typical street intersection with house lines, curb lines, etc., printed on it. Whenever and wherever such a crew is called for work, the foreman is required in his spare minutes, which always occur in such an operation, to list up on these blanks such data as an intelligent inspection of his immediate vicinity will discover. He likewise is required to operate such valves as can be conveniently handled and turn in a record of such operation. These field records are sent in to a central office and are used in verifying permanent records or for making new records on the detailed per diem maps.

3. The proper recording of new work and the reduction to tangible shape of existing data.

February, 1915.

The system in vogue in Philadelphia depends upon the centralized overhead control. All new work is directed from a central office, thereby insuring uniform practice and procedure, stimulating branch offices by the feeling that their returns are scrutinized and compared with similar returns from other branch offices. As the attempt is made to secure results from what would otherwise be lost time, or, in other words, a utilized by-product, this introduction of competition is valuable. Uniform practice and procedure are essential, as a man transferred from one section of the city to another feels at home among the familiar records, even tho the geography of the district is strange.

Book records have been discarded as far as possible in favor of records capable of easy and rapid reproduction. A complete and satisfactory record, distributed as widely as desired, may not be obtained for some time to come, but enough has already been accomplished to prove the worth of the system.

Combination Street Sweeper and Sprinkler

The accompanying photograph shows a combination street sweeper and sprinkler which has several points of advantage. The machine does the work of both sprinkler and sweeper in a very satisfactory manner.

The sweeper is the regular Acme sweeper of the Studebaker Corporation of South Bend, Ind., nearly all of which is clearly seen in the photograph. The steel frame and the wheels show for themselves. The equalizing lever for raising and lowering the broom is seen by the side of the driver's seat. The iron shield in front of the broom, the apron seen outside the large rear wheel at the left of the picture and proper sprinkling ahead of the machine keep the dust down to a minimum.

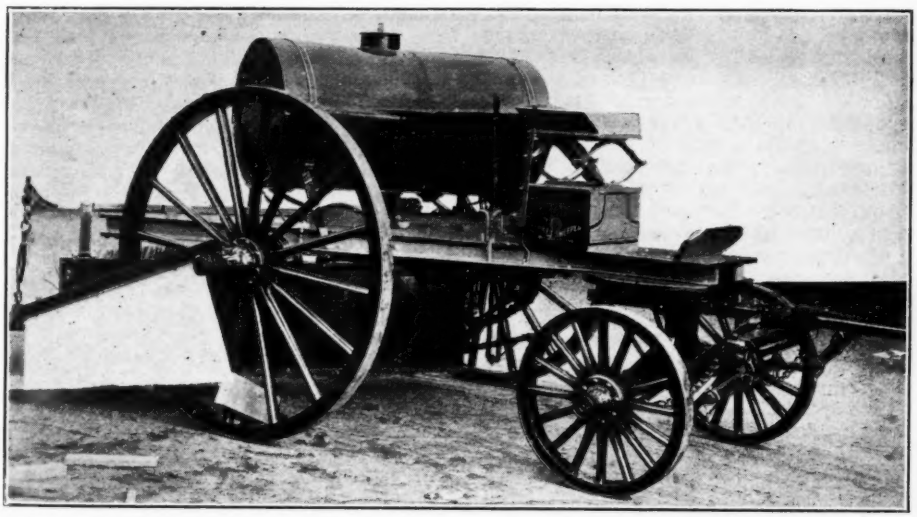
The sprinkling attachment consists of a 175-gallon galvanized steel tank, mounted on top of the frame behind the driver's seat, as shown. Water from this tank is discharged thru its bottom by means of a perforated pipe seen in the picture, running parallel with and just in front of the broom. The lever nearest the driver's seat opens and closes the valves controlling the discharge of the water, which are so constructed that more or less may be delivered, according to the needs for dust-laying purposes.

A few of the cities using this combination machine are Salem, W. Va., West Newton, Pa., Moultrie, Ga., Winston-Salem, N. C., Jacksonville, Fla., El Paso, Tex., Portage, Wis., Krugman, Peru, and Van Buren, Ind.

Automobile Fire Apparatus for Grand Rapids, Mich.

At a recent meeting of the Board of Police and Fire Commissioners of Grand Rapids, Mich., it was decided to place an engine in Station 12 and to put an additional automobile fuel wagon in service.

All the ladder companies in the city now have automobile apparatus. The chief officers have been provided recently with automobiles, also two of the larger engines with tractors, and five more automobile hose wagons and two chemicals have been provided.



Cost of Maintaining Automobile Fire Apparatus

From the report of the department of fire and police of Chattanooga, Tenn., for the year ending September 30, 1014, the following figures are taken as to work done by automobile fire apparatus and cost of maintaining them:

	Chemical.	Engine.	Chief's Car
Alarms answered	320	147	.....
Miles traveled—			
At work	1,122.6	409.9	.....
Exercising ...	266.4	524.7	.....
Chemicals used, gallons	5,097	.....	.....
Feet hose laid at fires	16,500	13,350	.....
Feet ladder used	1,107	.....	.....
Time pumped—			
At fires	....	12 hr| 35 m.	....
Practice	....	3 hr. 15 m.	....
Supplies and repairs cost	$311.22	$218.22	$381.47
New equipment cost	.....	25.01	.....

Improvements in Fire Protection for Philadelphia

Of the funds available from Philadelphia's $11,300,000 loan bill of November 19, 1914, only $100,000 was apportioned to the fire department for the purchase of new apparatus. With this it is planned to motorize five outlying engine companies, one other engine now having a motor hose wagon, and two centrally located trucks, and to purchase five new automobile ladder trucks and two automobile combination hose wagons. It is possible also that provisions may be made for the purchase of four more automobile combination wagons and one automobile pumping engine, for establishing one new engine company and three additional hose companies.

Approximately 50 per cent. of the engines at present in service are old and of an obsolete type, and it is difficult to keep them in condition to deliver even as much as half their rated capacity. Extensive repairs on these engines are not justified, and provision should be made each year for the replacement of a certain number of the poorest ones.

The fire-boat, altho recently repaired, is old and of very unsatisfactory type.

As to the water supply, provision has been made for a 48 and 36-inch belt line supply main for South Philadelphia, a 48 and 36-inch supply main across the central portion of West Philadelphia, preliminary filtration and sedimentation basins at the Torresdale plant and the expenditure of about $100,000 for reinforcement of the general system of distribution.

The average annual per capita expense of maintaining the Philadelphia Fire Department has for years approximated 53 per cent. of that borne by the eleven other largest cities of the United States.

Improvements are recommended by the Fire Underwriters as follows:

1. Establish ladder companies with Engine Company 20 in a new station near the present location; at Broad street and Montgomery avenue; with engine companies 40, 41, and 55 or 42.

Additional companies are at present needed at or near Washington avenue and 3d street and Spring Garden street and Ridge avenue, but with the two nearest ladder trucks to each of these locations motorized, these two new companies would no longer be required.

2. Purchase a new water tower and place in service with Ladder Company 2.

3. Establish an engine company in the vicinity of Chester avenue and 54th street.

Unless the three nearest engine companies are motorized in the near future, additional engine companies are also needed in the vicinity of Kensington and Tioga streets and of Media and 54th streets.

4. Establish regular and systematic tests of all engines and of the hose that has been in service over 3 years. Recent tests resulted in purchasing about $15,000 worth of hose with more to follow.

5. Replace during each of the next three years at least ten of the old fire engines.

6. Provide a more rapid extension of the underground system where ducts are available, particularly in all closely built sections, using No. 14 rubber insulated copper wire with extra heavy lead sheathing.

7. Increase the number of box circuits so that not more than twenty boxes shall be connected to any one circuit.

8. Provide for a reduction of the excessively high rates of consumption by the more rapid installation of meters.

9. Provide for the installation of the 60-inch supply main from Lardner's Point station to the distribution system.

10. Provide all possible means for carrying out the general plan of the department, whereby the pressures in the congested value districts will ultimately be raised to approximately 90 pounds.

Municipal Problems

Charter Changes for Los Angeles

On the last day of 1914 the citizens of Los Angeles, Cal., vote on the following proposed changes in their city charter, the cities of California having a large measure of home rule:

1. City manager; abolition of boards and commissions; appointment of department directors; eight councilmen, with mayor president of council.
2. Establishment of boro system for annexed territory to create market for surplus aqueduct water.
3. Authority of the city to issue investment, district and revolving fund bonds to handle the district bonds voted by the newly-formed irrigation district in San Fernando valley and others.
4. Elevation of tracks to parallel streets as well as to cross.
5. Appointment of members of school board by mayor and council.
6. Street railway subway under Silver Lake park and others.
7. Consolidation of city and county tax offices, letting county do the work now done by both city and county tax assessment and collection service.
8. Minority representation, allowing groups of voters to have proportional representation on council.
9. Donations for public parks to be handled by special commissions, thus doing away with such controversies as that between Griffith J. Griffith and the park commission.
10. Authorizing harbor commission to make emergency purchaser.

Municipal Police Departments — Their Relative Size.

Compiled by Andrew Linn Bostwick, Municipal Reference Librarian, St. Louis Public Library.

These tables attempt to compare the police forces of the largest cities as to size only. They do not purport to draw any conclusions as to the efficiency of the departments, or any other similar question. It should be borne in mind that tables of this sort are useful only in giving a general idea of the subject. To make a more exact comparison of the sizes of police forces it would be necessary to conduct a most exhaustive study and consider a great many factors that have not been reckoned with here.

The information in the tables is practically all up-to-date. The statistics as to street mileage and number of patrolmen are taken from letters received from official sources in December, 1914. The population figures are those given by the Census Bureau as estimates for 1914; the figures as to area of cities are taken from the World Almanac, which, in turn, received the information direct from the municipalities.

Columns I to IV of the tables are self-explanatory.

Column V shows the total number of patrolmen on the police forces, whether assigned to beats or not.

Column VI shows the average number of patrolmen working at a given time, on beat duty or otherwise. Each city has its own way of dividing its force into two or three platoons, and the systems vary so greatly that in making a general comparison the simplest procedure is to divide the total number of patrolmen by the number of platoons, and compare the results thus obtained.

Columns VII and VIII are self-explanatory.

Column IX furnishes a good basis of comparison—the number of patrolmen on duty per unit of population. (See note to Column VI, above, for explanation of term "on duty.")

Column X is self-explanatory.

Column XI shows another good basis for comparison—the number of patrolmen on duty per unit of city's area.

Column XIII expresses in another form the comparison shown in Column IX.

Column XIII furnishes another basis of comparison—the number of miles of street per patrolman.

Column XIV shows the number of miles of improved streets per patrolman. This again furnishes a good means of compar-

ison. The sections of a city that are built up to any degree, and sufficiently populated to need any amount of police service, are generally those sections that are served by improved highways. Unimproved streets in many cases are mere "paper" streets, in areas not populated at all. For these reasons Column XIV should be considered.

City.	Area in sq. mi.	Population U. S. estim. 1914.	Miles of streets.	Miles of improved streets.	No. of patrolmen.	No. of same on duty (average).	No. of platoons.
	I.	II.	III.	IV.	V.	VI.	VII.
New York	326.8	5,333,537	3,390.00	2,055.00	9,258	3,086	3
Chicago	191.3	2,393,325	2,991.41	1,759.87	3,407	1,136	3
Philadelphia	129.5	1,657,810	1,587.21	1,374.01	3,190	1,063	3
St. Louis	61.3	734,667	932.62	642.39	1,400	467	3
Boston	47.3	733,802	568.03	528.05	1,400	467	3
Cleveland	51.8	639,431	852.00	530.00	680	340	2
Baltimore	31.5	579,590	555.00	515.00	790	263	3
Pittsburgh	41.0	564,878	1,060.00	540.00	699	233	3
Detroit	41.8	537,650	700.00	462.50	908	303	3
San Francisco	46.0	448,502	824.00	414.00	766	255	3
Milwaukee	25.6	417,054	600.00	392.00	500	167	3
Cincinnati	70.0	402,175	971.50	611.50	520	173	3
New Orleans	196.0	361,221	525.00	294.85	245	123	2

City.	No. of patrolmen per 10,000 population.	No. patrolmen on duty per 10,000 population.	No. patrolmen per sq. mile of city's area.	No. patrolmen on duty per sq. mile of city's area.	Population per patrolman on duty.	Miles of streets per patrolman on duty.	Miles of improved streets per patrolman on duty.
	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
New York	17	5.7	28	9.3	1,728	1.1	0.67
Chicago	14	4.7	17	5.7	2,107	2.6	1.5
Philadelphia	19	6.3	25	8.3	1,560	1.5	1.3
St. Louis	19	6.3	23	7.7	1,573	2.0	1.4
Boston	19	6.3	30	10.0	1,571	1.2	1.1
Cleveland	11	5.6	13	6.5	1,881	2.5	1.6
Baltimore	14	4.7	25	8.3	2,204	2.1	1.9
Pittsburgh	12	4.0	17	5.7	2,424	4.5	2.3
Detroit	17	5.7	21	7.0	1,774	2.3	1.5
San Francisco	17	5.7	17	5.7	1,692	3.1	1.6
Milwaukee	12	4.0	20	6.7	2,497	3.6	2.3
Cincinnati	13	4.3	7	2.3	2,325	5.7	3.5
New Orleans	7	3.5	1	0.5	2,937	4.3	2.4
Average, 13 cities	**15**	**5.1**	**19**	**6.4**	**2,021**	**2.8**	1.8

Municipal Government in Germany

One of the most valuable practical treatises on municipal government which has appeared is William Harbutt Dawson's "Municipal Life and Government in Germany." The author is an Englishman and his book is a comparison of German and English methods of municipal government and of supervision of municipal activities by the central state authorities.

The methods on the whole are so different in the two countries and the results are so correspondingly different that by the time the full comparisons are made we have considered municipal government from almost every possible viewpoint and have some knowledge of the practical results of almost every method which has been applied.

German cities have a long tradition of self-government which is still almost

wholly in practice, notwithstanding the development in later years of the theory and practice of an exceedingly strong central state government. Strange as it may seem, therefore, in an empire in which the central idea is the supremacy of the state, the individual existing for the purposes of the state, rather than the state existing for the benefit of the individuals composing it, we have in practical operation the nearest approach to home-rule in the management of city local affairs which is in existence anywhere.

The various parts of the German Empire have developed according to different systems, and the laws governing cities conform to a large extent with the courses of these developments, so that methods and details are by no means uniform in the cities and towns of the empire. This is particularly true of the details of distribution of administration powers, application of the elective franchise and control of finances.

Ownership and control of land by municipalities, planning of towns and housing policies are under much more direct control of the municipal government than in this country.

Public health and police matters are administered by the local authorities, but are much more directly under the supervision of the central government of the state than are the other municipal activities.

The author shows in detail the various methods in vogue for operating or controlling municipal public service utilities and the extension of such control and ownership beyond the lines usually followed in this contry. Relief of the poor, social welfare work, education, theaters and their municipal operation are also explained.

Municipal financing methods, including taxation of local incomes, real estate, trade, consumption and other taxes which we treat under license systems are fully set forth.

The book closes with a general survey and comparison with English municipal conditions and a series of appendices going into special detail in some important lines.

The author is strongly impressed with the efficiency of German municipal administration. It is interesting to note that this efficiency is attained under a system which is mainly the old bi-cameral city council and mayor, with some differences in methods of election, which we in this country have been trying to discard as out of date and a prevention of proper progress.

It is still more interesting to note that the German efficiency is in large part due to the operation of three principles which we have largely neglected or refused to apply.

The first of these is the divorce of municipal affairs from party politics. This goes so far that a city cannot memorialize parliament with respect to its relations with the central government, because it is not constitutional for a city to pay any attention to political affairs outside its own interests. Councilmen are selected without party or any formal nominations, and, with a very few exceptions, have not been voted for because they belong to any political party.

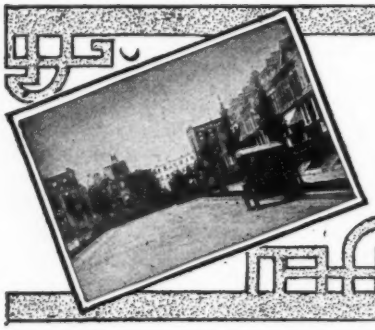
Second, the administration officials, from the mayor down, are selected on a merit system, seldom so iron-clad as our civil service systems under political nominations are likely to be, and are chosen without reference to their place of residence. As a consequence, there is a profession of municipal administration, just as there is a profession of teaching in this country, and men are promoted from one desk to another, from one department to another, from one city to another, as they demonstrate their fitness to fill the vacancies which occur.

Employment being during good behavior and the lines of promotion being so many and various, really capable city officials are kept up to the height of their efficiency at all times, and those who demonstrate their inefficiency can be dropped without arousing the opposition of a party machine which may shake the whole structure even up to the President.

Third, while the central government apparently has the right, or the strength to assume the right, to interfere in municipal affairs, and has the veto on any elections or appointments, it does not actually interfere in the conduct of municipal affairs by the local officials, and, in any event, it is not possible, as with us, for a group of persons or even a single person with influence in the State Legislature to bring about a change in the form of city government or the term of office or compensation of city officials in cities of a certain class in order to attain his own ends in his own city or to get even with city officials who have not fulfilled his desires.

While some of the changes in form of government in this country have been effective, at least for a while, none of them are effective everywhere and all the time. All three of the principles so prominent in German administration have been advocated in this country, but when tried it has only been half-heartedly or one at a time, and the others have remained to neutralize the good effects of the one. German experience is so definitely satisfactory that it is practically certain that the American city which will first apply the above principles will score the first lasting success.

February, 1915.



MISCELLANEOUS

The X Book

One of the most convenient books for the desk of the busy man for his daily use is one called the "X" Book, because it supplies the unknown factor in the problem of keeping track of many things which are before so many busy executives.

It divides the business day into 15-minute periods from 7 until 6, and has space in each division for engagements, record of what was done and when, has a space for a list of the ten most important engagements of the day and a calendar column with space for general memoranda. Each day in the year has a double page of space and the leaves are bound so that the book will lie open anywhere. A bookmark serves to fix the location of the day passing, or any other important page.

As an advance record of coming engagements, a tickler to call attention to the matters of the day and a record of what has been done, there seems to be nothing more to be desired.

G. A. Annable, 47 Broad street, New York, is the publisher and will send the book for $2 in cloth or $2.80 in flexible leather, or it will be sent from this office on receipt of the price.

Iowa Convict Labor on Roads Becomes Self-Respecting

The convicts working on the roads in Iowa have a status differing from that of the convicts in the prisons of practically all other states. In Iowa the men working on the roads receive $2.50 per day for their labor, they themselves paying for their keep and clothing and being at liberty to send the balance to their dependent families. They are still under restriction, but their right to wage lifts them out of the slavery status into that of state wards.

The action of many states in placing those prisoners who can be trusted out to work on the roads is a forward movement. On the roads the prisoner can do work which has value great enough to permit the payment of the wage. Iowa has proved the plan practical; West Virginia, New Jersey, and other states are successfully passing thru the experimental stage, while many more states will enact legislation permitting such work during the coming sessions of the legislatures.

Chats, Chert and Slag as Road Materials

In Missouri a considerable amount of road material is obtained from the tailings of the concentrating mills at the zinc mines. This material, which is put on the market as "chats," consists of small angular fragments of chert and limestone. The zinc companies are very glad to get rid of this waste material, which is loaded on the cars by the railroads of the district at a cost of about 6 or 8 cents a ton. It makes more than ordinarily good roads and is widely distributed all thru the Middle West. It sells in most places at prices ranging from 50 cents to $1 a ton, but in the neighborhood of the mines it can be had for about 15 cents a ton. It is used for railroad ballast as well as road making. The annual output, according to the United States Geological Survey, amounts to about 1,300,000 tons.

In Tennessee and Alabama a quantity of chert is used for road metal, and in many States crushed slag from blast furnaces also furnishes a valuable road material. In Alabama, one of the large iron-producing States, over 2,000,000 short tons of furnace slag, the average value of which was about 25 cents a ton, was crushed and put on the roads last year. Crushed slag is also used as railroad ballast and for concrete and roofing material.

Technical Associations.

The third annual meeting of the Chamber of Commerce of the United States is held in Washington February 3, 4 and 5.

The subjects of the Federal reserve act in relation to trade expansion, the development of the merchant marine of the United States, the Federal trade commission, rural credits, work of the Bureau of Foreign and Domestic Commerce, trade expansion and the European war, trust legislation and related topics are discussed by the recognized experts in these matters. One evening is devoted to an address by President Wilson.

The American Concrete Institute meets February 9 to 12 in connection with the Chicago Cement Show. A full program of papers on concrete roads, curbs, bridges, culverts, wall columns and beams, stands, stadiums and bowls, bins, sewer pipe, concrete surfaces, reinforced concrete in buildings and various large and small structures, plants and forms for handling and placing forms, properties of cement, fireproof construction and architectural expression in concrete has been arranged

The National Civic Federation has issued a "Memorandum of Suggestions" upon main provisions requisite to an adequate compulsory workmen's compensation law.

The National Conference on City Planning, Flavel Shurtleff, secretary, 19 Congress street, Boston, Mass., now has five volumes of proceedings of annual conferences which can be obtained at $1.50 each for the first two and $2 each for the others, plus transportation charges. The organization also has published eight bulletins, for sale at 10 cents each, or $5 a hundred, except one, for which the charge is 30 cents. The 1915 conference will be held in Detroit.

The American Wood Preservers' Association at its Chicago convention, January 19-21, sustained its reputation for valuable papers and discussions, one of which will be found elsewhere in this number. F. J. Angier, B. & O. R. R., Baltimore, Md., is the efficient secretary.

The Minnesota Surveyors and Engineers Society will meet in St. Paul, February 19 and 20. Geo. H. Merrold, City Hall, St. Paul, secretary.

Resolutions demanding a combined meeting of the American Highway Association and the American Road Builders' Association were drawn up and signed by twenty-five of the leading exhibitors at the Chicago Road Show. The resolutions read: "Resolved, that unless the American Highway Association and the American Road Builders' Association agree to combine upon one time and place for the holding of a single annual meeting national road congress, we, the undersigned manufacturers, positively agree to make no exhibits whatever at any national road congress." It is expected by those adopting the resolutions that all the exhibitors will support the measure. A factor which contributed to the success of the convention from the exhibitor's standpoint was that to a great extent the visitors lived in communities interested in hard-surfaced roads.

The meeting of the New England Water Works Association at the Hotel Brunswick, Boston, Mass., February 10, has for its principal feature discussions of the reports of the committees on meter rates and on filter statistics. Willard Kent, secretary, Narragansett Pier, R. I.

Technical Schools.

The University of Michigan, Ann Arbor, Mich., issues a booklet of 20 pp. descriptive of the full courses in highway engineering carried on during the entire year. A short course will be held during the week of February 15.

The Yearbook of the Michigan College of Mines, Houghton, Mich., contains the schedule of courses and full information about the school and its facilities.

Recent lecturers before the Columbia University graduate school of highway engineering were Edward D. Boyer, expert of the Atlas Portland Cement Company, on "The Construction and Maintenance of Cement Concrete Pavements"; William A. Howell, engineer of streets and highways, Newark, N. J., on "Specification for Physical Properties of Paving Bricks and Stone Blocks"; Nelson P. Lewis, chief engineer New York Board of Estimate and Apportionment, on "Planning of Streets and Street Systems"; C. N. Forrest, chief chemist Barber Asphalt Paving Company, Maurer, N. J., on "Production of Bermudez and Trinidad Asphalts."

The short course in Highway Engineering to be held at the University of Illinois January 11-22, was postponed owing to the danger of spreading the foot and mouth disease now epidemic in Illinois.

The Case School of Applied Science, Cleveland, O., followed the prevailing fashion with a short course on highway engineering January 18 to 26.

In University Extension Bulletin No. 8, prepared under the Bureau of Municipal Information of the University of Iowa, Iowa City, is a collection of "Water Statistics of 38 Cities of Iowa with the Meter Rates of 70 Cities," by John H. Dunlap.

The January list of lecturers before the Columbia University graduate school included Walter H. Fulweiler, chief chemist, United Gas Improvement Company, Philadelphia, Pa., on "Manufacture of Water Gas Tar"; Philip P. Sharples, chief chemist, Barret Mfg. Co., New York, on "Chemistry, Manufacture and Testing of Refined Coal Tars and Methods of Trans-

portation"; W. W. Crosby, chief engineer, Maryland Geological and Economic Survey, and consulting engineer, Baltimore, Md., on "Preliminary Investigations in Highway Engineering, Value and Methods Employed"; William H. Connel, chief of Bureau of Highways and Street Cleaning, Philadelphia, Pa., on "Special Features in Street Cleaning Work, Snow Removal and Annual Municipal Clean-up Week."

Civil Service Examinations.

The United States Civil Service Commission will hold examinations at the usual places as follows:

February 10: Aeronautical mechanical engineer in Signal Corps Aviation School at San Diego, Cal., at $2,400 a year.

February 24-5: Hull draftsman under Chief of Engineers, U. S. War Dept., at $1,800 a year.

March 10: Aid and laboratory apprentice, Bureau of Standards; aid, and computer, Coast and Geodetic Survey; assistant examiner, Patent Office; copyist typographic draftsman, topographic draftsman, junior chemist, statistical clerk, departmental service; junior engineer, Engineer Department at large; superintendent of construction, Supervising Architect's Office; surveyor, Philippine service.

April 14: Civil engineer and draftsman; computer, Nautical Office and Naval Observatory; copyist ship draftsman, Navy Department; mechanical draftsman, and topographic draftsman, Panama Canal service; engineer, Indian service; junior mining engineer, Bureau of Mines; laboratory assistant, Bureau of Standards.

The Illinois State Civil Service Commission holds examinations at 15 places on February 6 for assistant utilities engineer at $90 a month, increasing to $125. Also on March for junior engineer under the State Highway Commission at $75 a month, increasing to $100.

Personal Notes.

Jos. F. Barton is the new mayor of North Yakima, Wash., which has had the commission form of government for three years, this being the second election. He is the superintendent of the department of public safety. Wilbur Crocker, superintendent of finance and accounting, and Harry Coonse, superintendent of streets and public improvements, are re-elected and chosen for their positions by the commission. The election followed a primary in which there were four candidates for nomination for mayor and seven for commisisoners, reduced to two and four respectively for the second election.

The city commissioners of North Yakima, Wash., have appointed for terms of three years Leonard O. Meigs as city attorney, Benjamin F. McCurdy as chief of police, N. A. Gilman as city engineer, E. G. Dawson as fire chief.

E. B. Van de Greyn has opened offices at 725 Chronicle building, Houston, Tex., for practice as a consulting and constructing engineer, devoting himself particularly to municipal and sanitary engineering, including drainage, irrigation and bridges.

F. V. P. Ellsworth, formerly city engineer of Hot Springs, Ark., is now assistant city engineer of San Antonio, Tex., in charge of paving.

Hazen, Whipple & Fuller is the new name of the firm, made by adding W. E. Fuller. Water works, sewerage, sewage disposal and drainage are their lines of practice, and their offices are at 30 East 42d street, New York City.

Charles Henry Davis, South Yarmouth, Mass., and Fred J. Miller, New York, are two engineers recently appointed members of the Simplified Spelling Board.

George W. Lawson, for some years with the Union Oil Company of California, will hereafter represent the Standard Oil Company of New Jersey and their Standard paving asphalt, made from Mexican asphaltic petroleum. He will also have a high-grade California asphalt. M. A. Giff will be associated with him in his new venture. Their offices are at 1451 Railway Exchange, Chicago, Ill.

Frederick C. Noble, M. Am. Soc. C. E., has opened an office at 50 Church street, New York, for consulting practice.

James R. Valk has been appointed western sales manager for the United States Asphalt Refining Company, with offices in the Harris Trust Building, Chicago, Ill.

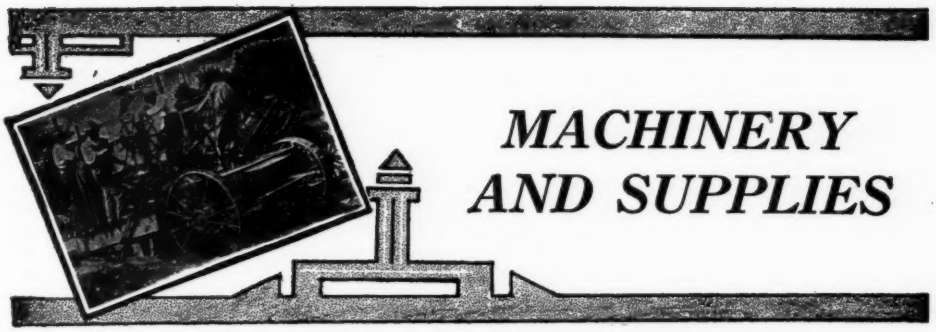
Publications Received.

Studies on the Silver Votameter are contained in No. 240 of the Scientific Papers of the Bureau of Standards, U. S. Department of Commerce, Washington, D. C.

Report on industrial wastes from the stockyards and Packingtown in Chicago, made to the Board of Trustees of the Sanitary District of Chicago by Geo. M. Wisner, chief engineer; Langdon Pearse, division engineer; Arthur Lederer, chemist; L. C. Whittemore, resident engineer. Paper, 346 pp.

Annual report of the Smithsonian Institution for 1913, Charles D. Walcott, secretary, Washington, D. C. Cloth, 804 pp.

Annual report of the U. S. Secretary of Commerce, Washington, D. C., for 1914. Paper, 214 pp.



MACHINERY AND SUPPLIES

A Snow Plow For Street Use

In these days of heavy snowfall the Twentieth Century snow plow, sidewalk and gutter cleaner is a machine of much interest. It is a snow plow, throwing snow in either direction, as it may be set, which cuts down to the pavement beneath, leaving it practically clean. There are one-horse and two-horse plows or graders, which can be used to clear sidewalks, gutters or street car tracks or to throw snow into windrows for removal by wagons. In one town it saved one-third the cost of cleaning cross-walks of snow by hand. In another northern Minnesota town, with heavy snowfall, one man with team and plow kept clear seven miles of sidewalks, six feet wide.

All the levers for handling the machine are in direct reach of hand or foot of the driver on his seat.

By changing blades the machine can be used as a mud scraper, ice scraper, stone spreader, ditcher and road grader as well as snow plow.

The Baker Manufacturing Co., Springfield, Ill., will give full details on application.

Sand Spreader for Pavements

City officials who are troubled with slippery streets, so common at this season of the year, should examine the Kindling sand spreader, which will cover such pavements with a thin, uniform layer of sand or gravel. Some cities try to cure slippery streets by hand-spreading of sand and some are prevented from trying this method because of lack of funds to meet the expense. The Kindling sand spreader will sprinkle 50,000 square yards of pavement per hour with sand or gravel, doing the work of fifteen or twenty men. Some materials will scatter farther than others, but this spreader will cover at least 20 feet with any suitable material, and from 50 to 60 feet with others. A lever regulates the flow of sand or gravel and the rate of scattering, and the driver operates the lever, so that but one man is needed.

Any materials from the finest sand to 1¼-inch stone can be handled by the machine. It is made by the Kindling Machinery Co., Milwaukee, Wis., the well-known makers of the Kindling squeegee for scrubbing city pavements.

Medusa Waterproofing Patent Sustained

The United States Court of Appeals, Seventh Circuit, rendered a decision on January 4, 1915, fully affirming the decision of the United States District Court, Northern District of Illinois, rendered February 13, 1914, by which the Newberry patent No. 851247 was declared to be good and valid, and that the McCormick Waterproof Portland Cement Co. infringed said patent. This is the patent on Medusa water-proofing for cement, made by the Sandusky Portland Cement Co., Sandusky, Ohio.

Old Block of Concrete from Panama Canal at Chicago Cement Show.

A cube of the first concrete made by the old French Canal Company in 1886 has been received in Chicago for exhibition by the Universal Portland Cement Company at the eighth annual Chicago Cement Show, February 9 to 16, in the Coliseum.

Altho the old concrete was formed in blocks like cut stone and not made monolithic, as in all the later construction, its endurance under severe weather conditions is remarkable. The materials used were a portland cement, Bohio rock and Panama beach sand.

In quoting the specifications under which this concrete was made Colonel Geothals says: "The Bohio rock is volcanic agglomerate of rather low specific gravity and medium hardness, but very resistant to atmospheric weathering. Dur-

ing severe "northers" the breakers have, sometimes, been strong enough to roll the blocks upon the beach." The French records of the contract of 1886, under which these blocks were made, contain the following specifications:

"Stone to pass through a ring 0.06 m. diameter, and to be washed and screened to eliminate all particles smaller than 0.02 m. diameter. The cement mortar to be composed of 800 kilogrammes of cement to 1 cubic meter of sand. These materials to be mixed dry upon a wooden platform under a roof, and water to be added by means of a sprinkling hose, taking care to use only as much water as may be necessary to produce a homogeneous mortar, which will stick to the shovel. The concrete to be composed of two parts of mortar and three of stone. After the mortar shall have been mixed as specified above, add the stone and mix with an iron hoe, until all of the stone shall be completely covered with mortar; the mixing to be accomplished without further addition to water, the stone, however, to be watered carefully in the pile at least one hour before using. The concrete to be dumped into forms and compressed to a compact mass. Repeated ramming to be carefully avoided."

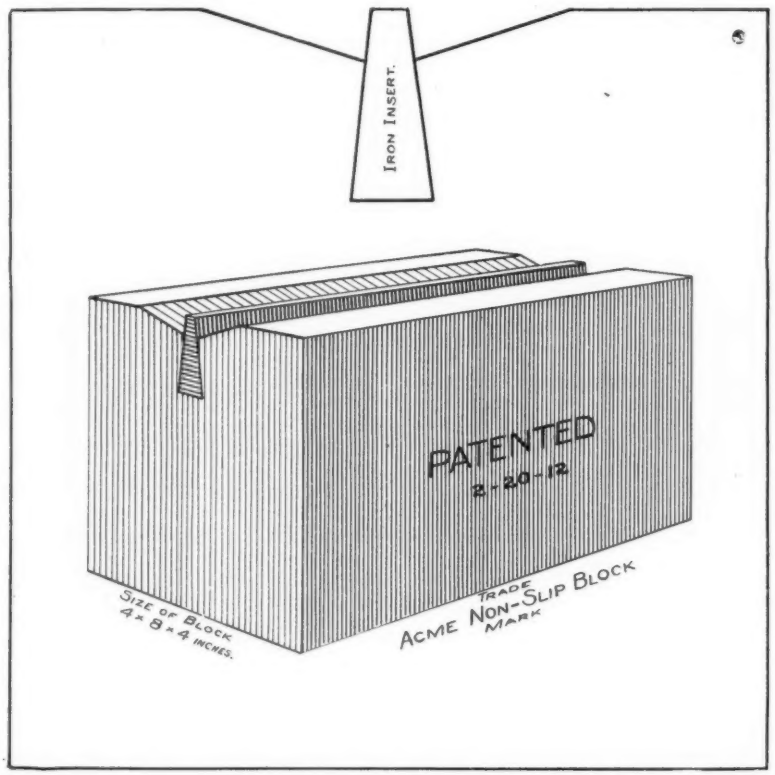
A Non-Slip Wood Paving Block

A type of wood paving which has been laid successfully in Boston and Philadelphia is designed to prevent the slipperiness complained of in certain wet or icy weather when a pavement is laid of rectangular creosoted wood blocks with smooth surfaces and close joints.

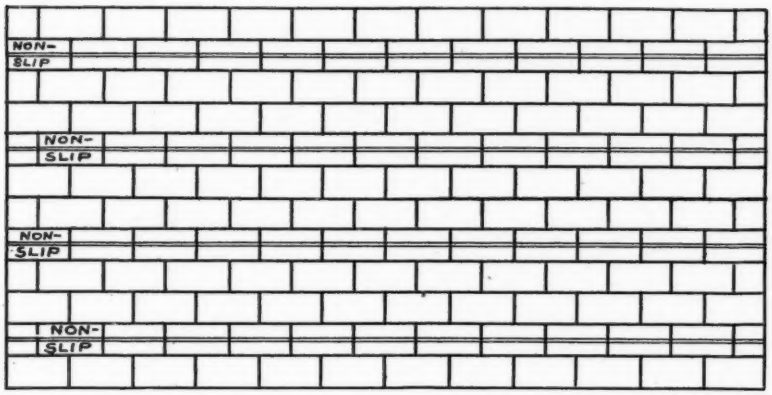
One of the accompanying drawings shows by its outside line the full-sized end of a block, from which it will be seen that its distinctive feature is a hollow in the upper surface with a re-entrant groove, in which is inserted an iron bar of trapezoidal section.

The inner drawing is an isometric projection of a completed block showing the special characteristics still more fully.

The blocks have been laid on two streets in Boston, where they have been in use for over three years. The pavement on Washington street, Dorchester district, is on rather heavy grade. More than 50,000 of the non-slip blocks were



NON-SLIP WOOD PAVING BLOCKS *with inserted steel strip. Outside line shows exact size and shape.*



NON-SLIP WOOD PAVING BLOCK *pavement, showing one row of non-slip blocks to two rows of common blocks.*

used on this street. The advantage to horses in preventing slipping are obvious, as they can secure firm, solid hold in pulling up grades. On a Philadelphia pier the blocks give horses the same advantage in starting heavy loads.

The second drawing shows the method of laying, the rows of blocks being laid perpendicular to the length of the street and non-slip blocks being used in every third row. Where deemed necessary they can be used in every second row.

As it takes forty 4 by 8-inch blocks to lay a square yard of pavement, 13 1/3 non-slip blocks and 26 2/3 plain blocks will be required for a square yard laid as shown in the design. If the non-slip blocks are laid in every second course half the blocks will be non-slip, and if in every fourth course one-fourth the blocks will be of the non-slip design. These blocks are, of course, more expensive than the plain creosoted blocks and the number of courses between courses of non-slip blocks will be chosen according to the necessities of the case as to accommodation of traffic on one side and as to cost on the other.

The Acme non-slip wood paving block is put on the market by the Philadelphia Wood Paving Block Company, Philadelphia, Pa., who will answer questions regarding them.

How Goodrich Tire Makers Went to War

War, and its effect on the tire industry of Europe, is graphically described by Arthur Lumsden, general manager of the French and English auxiliaries of the B. F. Goodrich Company, of Akron, Ohio, in a recent number of *The Automobile*.

"Our men had been paid as usual at noon on the Saturday France mobilized her army," Mr. Lumsden says. "At 4:30 o'clock the notices were issued putting the nation on a war basis. As our pay list is made up on Wednesday evening, arrangements were made for the cashier to be at the office on Sunday morning at 5 o'clock, in order that the men who were going to the front could collect their arrears of wages. In this way every man who left our works to go on active service went away fully paid.

"On Monday morning I was curious to see what the conditions would be at the factory. We found we had eighty men who were not eligible for active service. These men included most of those engaged in the band tire department. According to a previous arrangement with the French government, this department went under military control automatically as soon as war was declared, and we were put under an obligation to produce certain quantities of tires for army trucks." (This arrangement, it should be explained, is a part of the French army subsidy scheme. A couple of years ago Goodrich tires were admitted as part of the equipment of army subsidy trucks. Only the fact that the Goodrich company actually manufactures in France and has on its French board of directors men who have military responsibilities under the French law enabled this arrangement to be made.)

"London and Paris were violently panicky as soon as war broke out. The leading French tire firm, doing an immense business in England, called in all its stocks and refused to do business on anything but strictly cash terms. This move was followed immediately by the leading English firm. Dealers were decidedly annoyed at this action on the part of the heads of the French and English tire in-

dustry and expressed their dissatisfaction so forcibly that at the end of a couple of weeks the English company resumed business on the original basis. The curious feature of the situation is that both these companies took advantage of the patriotic wave, announcing 'Business as Usual,' 'Follow the Flag,' 'Stand by the Old Country,' 'Support British and French Industries,' etc.

"Practically our entire stock of tires, both at the factory and at the Paris stores, was requisitioned by the government. These tires were left in our hands, but could not be sold to the public, the army having the right to call for them at a moment's notice and pay for them according to a pre-established tariff, which is practically the price paid by dealers. There was no interruption in the production of band tires for trucks, but practically all we produced were taken up by the army. The strict regulations under which we have existed for a couple of months have been somewhat relaxed of late. We have been able to begin, on a small scale, the production of pneumatic tires, and also to offer some of our stock to the public. It is expected that within a few days arrangements will be completed whereby we can export to England, and thereby supply the European countries not involved in the war. We have continued to do a certain amount of business with those parts of France not occupied by the armies, but the difficulty here has been the lack of shipping facilities. We have never experienced any difficulties with regard to the supplies of raw rubber and fabric."

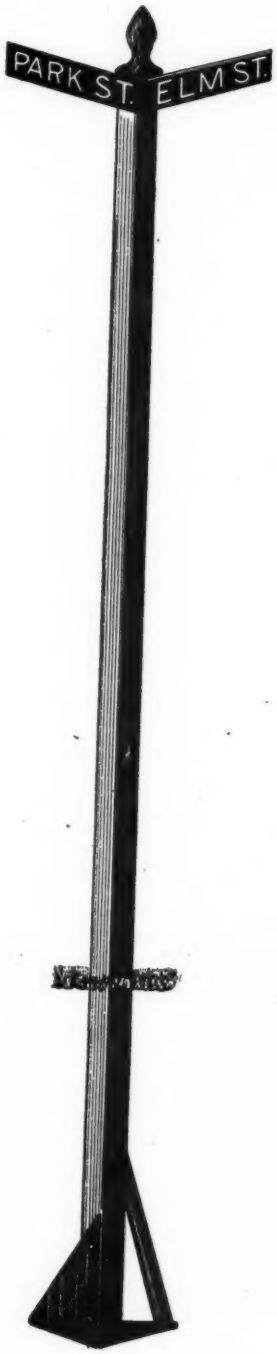
Street Sign Post

The accompanying drawing shows a very simple and comparatively inexpensive street sign post which has been introduced by the Enameled Steel Sign Company, 222 North State street, Chicago, Ill. This post is intended for use in parkways or lawns along the curbs of streets, and is one of several designs for various purposes and locations which the company has made.

The post is an angle-iron bar 2½ by 2½ by 3/16 inches, of the proper length to hold the signs 7 or 8 feet above ground, and to attach the anchors underground at depth enough, 30 inches, to keep the post upright against ordinary action of frost and shocks less than a runaway team or an automobile would give.

The signs are of enameled steel of the quality for which this company is known, and are simply attached to the flanges of the angle iron.

The bottom of the post is flattened and turned at a right angle to give a wide



horizontal flange. A 3/16-inch triangular plate is riveted to one flange of the angle iron and a brace to the other as shown in the drawing. If deemed necessary this base can be set in concrete to protect the post from rust and to give it more weight and stability.

This post is now in satisfactory use in Gary Ind. It costs $1.90 in lots of 100 or $1.70 in lots of 200. Further information will be given by the company above referred to if desired.

Corrugated Iron Culverts Convenient of Removal

These American ingot iron culverts offer all the advantages of the most approved culverts, with the additional merit of being light and easily transported to the place of installation, no matter how inaccessible.

They are most easily and quickly placed in position, and do not require the services of skilled labor. There is no element of chance connected with the use of these culverts, because there is no uncertainty as to them. There can not possibly be any question of structural weakness, inaccuracy of labor, defective materials. They can not come to you chipped in transit or with broken flanges. Coming in any required length or diameter, they may be placed in position with none of the difficulties incident to setting of joints with cement grouts, bracing against slipping and sliding while the joints are hardening, or any such common difficulties.

They possess another advantage not to be had in connection with the use of any other culvert material, namely, removability. By this we mean that these culverts may be taken out and reset, as may be desired when the grades of the roads are changed or the location of culverts is to be altered. There is nothing about them that requires any element of destruction, breakage, disconnection of attachment, or other sources of uncertainty, risk or complicated labor. For the private place, the farm, the park, or the public institution, summer resort, or cemetery, "Armco" culverts are peculiarly well adapted, inasmuch as such places are subject to frequent changes of landscape treatment, road and driveway construction and extension and the like. The lightness and inexpensiveness of this material renders it indispensable for these purposes.

For storm drainage of city streets a special form can be used, saving head room, but not at the expense of strength. This is the part-circle culvert of the National Corrugated Culvert Co., an example of which from Douglas, Ariz., is shown in the accompanying photograph. This culvert has a 78-inch base and 34-inch rise and carries storm water only.

The Proper Care of Lawns

The season for caring for lawns, golf courses and the like is at hand, and park and other officials should investigate and secure the best machinery for the purpose. The Velvetlawn line of grass and

PART-CIRCLE CULVERT *of corrugated in Douglas, Ariz.,* 78 *inches by* 34 *inches.*

clover drills and seeders, both hand and horse drawn, is worth investigation. The Velvetlawn Seeder Co., Springfield, Ohio, will send on request a booklet on the proper care of lawns, as well as catalog and price list.

Universal Portland Cement Company at the Eighth Chicago Cement Show

Practice in the field of concrete construction progresses so rapidly from year to year that the Universal Portland Cement Company annually avails itself of the offortunity for presenting new ideas at the Chicago Cement shows.

REMOVING SLAB OF CONCRETE *from Bellefontaine, Ohio, pavement for exhibition purposes.*

Much space in the eighth Chicago Cement Show will be devoted to showing the need for clean sand, stone and water, properly graded and selected aggregate and the need for thoro mixing and curing of floors, block, and tile. Various types of cement products properly made and cured will show the strength and water-tightness obtainable with good concrete. Specimens of factory floors cast in three sections will indicate good and bad methods of construction.

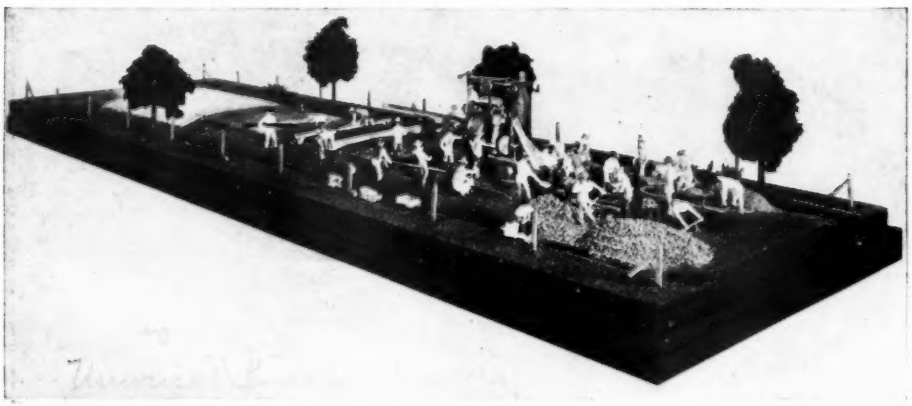
The good roads exhibit will include a model of a concrete road under construction showing the position of the mixer and the distribution of the working force. All details involved in the construction will be shown, including a section of the old dirt road upon which the concrete road is placed, a finished section of the concrete road itself, dirt covering for curing, stone shoulders along the finished section, pipe line for supplying water for mixing and sprinkling, and all the machinery and implements.

A section of the Bellefontaine, Ohio, pavement, laid in 1894, will be shown again. The original specifications for this pavement show many points of similarity with present-day best practice. A section of pavement from Woodward avenue, Wayne County (Detroit), Michigan, which was removed to permit making a suitable joint with the new Seven-Mile road, recently completed, will also be shown.

One of the many advantages of concrete roads is the fact that this type of pavement permits of building the concrete curb integral with the pavement itself. Charts show the usual construction, and others the approved practice of concrete paving between street car tracks.

On Twenty-first street, near the lake, is a two-course reinforced concrete pavement built to carry heavy traffic. From 1908 to 1913, a total of 129,744 square yards of concrete alley pavements were laid in Chicago. In 1914 alone the yard-

MODEL OF CONCRETE ROAD *under construction which will be a prominent feature of the exhibition.*



TWO-COURSE PAVEMENT *for heavy traffic on Twenty-first street, near the lake, Chicago.*

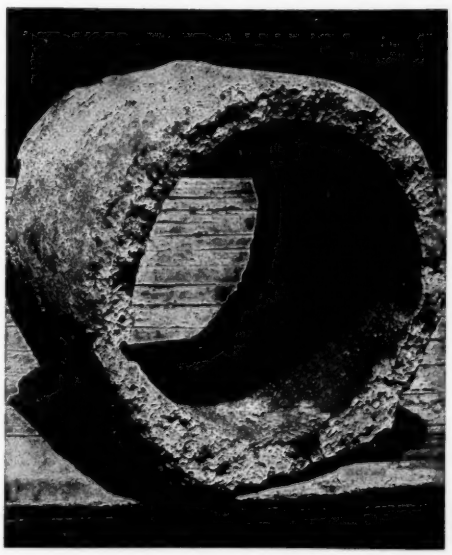
age approximated 125,000. Immediately outside of the city limits are many excellent types of country concrete roads.

One space will be devoted to the fireproofness of concrete. Its central feature will consist of transparencies showing the most striking scenes at the Edison fire, around which will be grouped smaller transparencies showing several pictures of this conflagration. Accompanying this will be an illuminated letter from Mr. Edison indicating his attitude toward concrete, his plans for rebuilding in concrete and an expression of his satisfaction in the manner in which his buildings stood up during the severe conflagration. The Salem fire will be treated in a somewhat similar manner.

The booth devoted to a portrayal of old concrete specimens will contain sections of concrete from Pompeii, Rome and Colon. A piece of concrete cut from a Nova Scotia bridge pier, cast in 1884 and subjected to tidal action ever since, will show how well concrete withstands such severe tests. Of less historical interest but of equal value in showing the permanence of concrete are sections of a street crossing laid in a North Dakota town in 1864, and used continuously for 30 years, a concrete block with granite facing subject to about 10 years of weathering, a 47-year-old piece of sewer pipe from South Bend, Ind., and a piece of sewer pipe from Bay City, Mich., more than 45 years old.

Concrete on the farm, in the garden, in decorations, will be shown. The economy of bulk cement will be demonstrated in one exhibit.

SECTION OF 45-YEAR-OLD CONCRETE PIPE *removed from Bay City, Mich., sewer to permit enlarging it.*



The Complete Workshop

Among the recent innovations calculated to arouse the interest of the educational world is a new workshop bench, known as "The Complete Workshop."

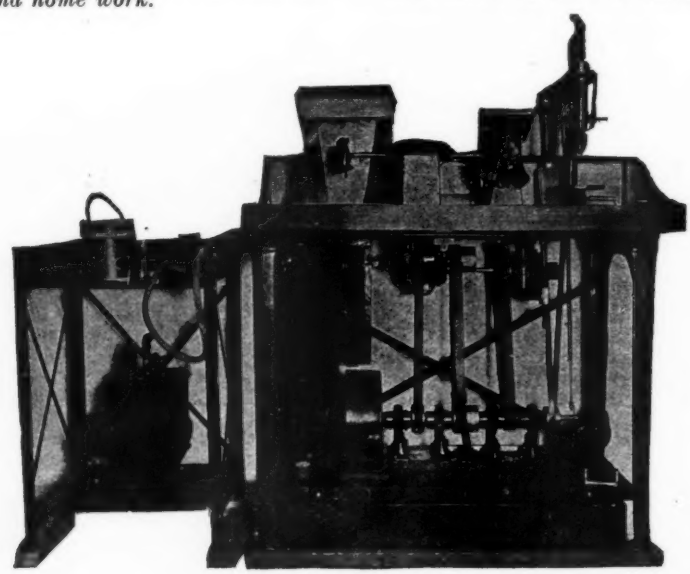
Almost every instructor has felt the need at some time or other of a small shop suitable for doing almost any kind of work, but in a great many cases space or the high rental cost of additional space forbids the installation of the necessary machines. The Complete Workshop has been designed for the purpose of obviating these difficulties, and making it possible to do all sorts of work in the educational line within the most limited space. Within a space slightly larger than the ordinary laboratory work bench would occupy are facilities for repairing and manufacturing which heretofore have required many times this space. The outfit is quite as well adapted for small manufacturing or repair work in connection with workshop or salesroom.

The polishing-dust collecting outfit forming the main part of this machine is exceedingly useful, not to say essential in the make-up of every workshop in the educational line, and especially to a shop connected with an ordinary salesroom or retail store. The use of this machine makes it possible to have the stock always looking fresh and bright by preventing the dust and dirt from flying all over the place. When repair work is done that requires buffing, the small particles of precious metals which are removed in this operation do not float away thru the air, but are drawn in by the powerful suction of air at both of the hoods, shown in the illustration, and deposited in the tank underneath the bench to be recovered subsequently and refined. Heretofore this material has been a total loss, but now it is possible to retain it and recover its value in new gold or other precious metals.

The drilling machine which is fitted with a high-grade chuck is capable of accommodating drills from 0 up to 5/16 inch. On the under side of the bench and fastened thereto is a pressure blower with the necessary pipe connections running over to the left-hand side of the bench, where arrangements are made to connect the air supply to the furnace, as shown on the iron stand alongside the bench, or in its place the sand blast shown underneath the furnace may be connected and used whenever required. It will be noted that all of these machines are connected by belts to the shafting shown on the lower platform, which in turn is operated by the motor hanging underneath the bench.

The motor supplied can be attached to electric lighting socket, and will give ample power to drive either of the individual machines, and is so arranged as to make it possible to operate them individually. The furnace table, as shown, is a separate table, which can be placed at the side of the polishing machine, or at any other part of the room. In this latter case it will only be necessary to increase the length of hose to carry the air.

The suction on the dust collecting outfit



COMPLETE WORKSHOP *for use in small shops or stores, for educational purposes and home work.*

is so arranged that by an arrangement of dampers an increased suction may be secured at either hood, according to the one that is being used. It will be noted that the machine is supplied with a small dust hood on one side, which may be used for small work, while on the other side a larger hood is shown, which is utilized when larger pieces are to be buffed.

The polishing head shown may be fitted with chucks for different purposes, such as sawing, turning, lapping and other operations.

The shaft bearings of the machine are self-lubricating, as also are the bearings of the pressure blower and motor. The bench is zinc-lined, so that it is easily kept clean, and the entire outfit may be operated from an ordinary electric light socket.

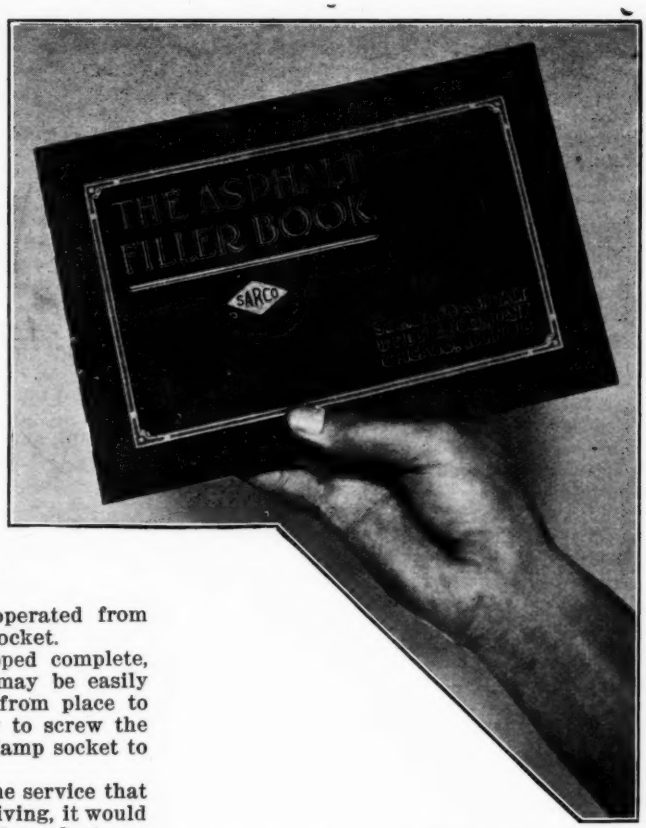
The entire outfit is shipped complete, set up ready to run, and may be easily handled and moved about from place to place. It is only necessary to screw the electric light plug into the lamp socket to begin work.

In order to secure the same service that this machine is capable of giving, it would be necessary to purchase independent machines which would cost a great deal more than this combination outfit costs, and it might be mentioned here that the cost of the outfit is very reasonable, so that a great demand is looked for among retailers, and especially among small repair shops.

The outfit is adapted for those doing small work as well as for educational work, and all of the different parts which are supplied with the machine are standard, well-constructed machines, and not in any sense experimental. The entire machine is substantially built and nicely finished, and its cost is very reasonable. The manufacturers of the outfit, Leiman Bros., 62 John street, New York City, will supply any additional information and prices for the outfit, which is the result of their twenty odd years of experience in manufacturing machinery.

Asphalt Filler for Brick Pavements.

The "Asphalt Filler Book," the outside of which is shown in the accompanying photograph, gives full information about the use of Sarco asphalt as filler for block



pavements. Specifications for fillers for various kinds of blocks and the various methods of applying them are fully stated. The quality of the service rendered by the booklet can be judged by the extracts from it made in the department, "From Workers in the Field," elsewhere in this volume.

Fiber Conduits

In the process of manufacturing Orangeburg fiber conduit wet wood pulp or fiber is wrapped in a minutely thin film upon a forming mandrel, under pressure, until the desired thickness of wall is obtained. The individual fibers become felted and form a solid, homogeneous wall. Taken off the mandrel, the wet pulp structure is subjected to a drying process, after which it is placed in a vat of liquid compound. This compound is a preservative and is also insulating and water-proofing. It thoroly permeates the entire structure, so that after treatment the wall of the conduit, when cut, presents a strong resemblance to hard rubber. The ends are cut in a lathe to make a socket joint,

sleeve joint or screw thread, as may be desired.

The same materials and general process are employed in producing bends of various degrees and radii, "S" bends, tees, elbows, crosses, couplings and junction boxes, with the varying number of outlets.

Stock on hand is stored winter and summer in the open yards of the manufacturing plant, the manufacturers thus demonstrating their confidence in the quality of the water-proofing and the perfection of the resistance of their product to the weather.

The third edition of the catalog of the Fibre Conduit Co., Orangeburg, N. Y., shows the many methods of installing the conduit pipes in the construction of multiple conduit lines for electric wires and cables. It also shows special uses for which the Orangeburg conduit is fitted on account of its resistance to corrosion by acids, weather, etc., and its strength, such as leaders to carry water from roofs, wall bushing for carrying cable and the like thru walls, conveying dilute acids, alkali or corrosive salt solutions, vinegar, etc., chemical containers, laboratory hoods and drainage channels, etc.

Single House Sewage Disposal.

Isolated country houses are sometimes confronted with the problem of sewage disposal, especially in these days when water supplies are ample, thru the use of wind mills or gasoline engines for lifting water, and the comfort of the dwellers in the house is duly considered.

Suburban houses to which the city sewer systems have not been extended, tho water pipes have reached them from the city supply, are in even more urgent need of a local method of disposing of sewage.

There are many small towns which have ample water supplies, but which have not yet had sufficient demand to warrant the construction of sewer systems because of the long lines necessary to reach all the residences and the consequent excessive expense.

All these classes of houses need residential sewage disposal plants. Quite a number of engineers design such plants upon request and have met with success in such practices. One of the engineers longest devoting himself to this kind of work and having one among the largest lists of successful plants to his credit is Burton J. Ashley, who, some years since, devised a simple and comparatively inexpensive plant, which he keeps fully up to date. The Ashley Sewage Disposal Company, Morgan Park, Chicago, Ill., is prepared to design and install such plants with full knowledge of the varieties of conditions met with, so that they should be able to meet any demands made upon them.

The Wonderful Growth in Wood Block Paving

By E. W. Church, Philadelphia, Pa.

Wood paving blocks, as we know them to-day, were but little used prior to 1900. A few cities had put down trial sections of wood block paving, but in each case the local engineer had worked out his own plan, no scientific data being available at that time.

From 1900 to 1908 the gain in wood block pavement was slow, the cities adopting this kind of pavement with great caution, but at the latter date the city engineers began quite generally to exchange data, and in consequence found that the laying of wood block pavement need not be wholly an experiment.

During 1908 some thirty cities laid wood block pavements, the amount laid in that year being about 800,000 square yards. From then until now there has been a constant increase in this pavement, and we find at the beginning of this year 150 cities using the wood block pavement, the amount so far laid being fully 10,000,000 square yards.

While there is much yet to be learned regarding treatment of blocks, method of laying, etc., the city engineers can now quite accurately determine the kind of wood best adapted, the proper amount of creosote saturation per cubic foot, and the best method of laying.

Ten million square yards of wood block pavement means that we have used up for this purpose practically 400,000,000 feet of merchantable lumber. At least 50,000,000 feet of lumber will be used up in wood block pavements during 1915. This brings us face to face with the great problem of to-day: The conservation of our timber.

Trade Notes

Among the contracts recently awarded to the Raymond Concrete Pile Co. are concrete piles for the foundation of a new power house for the Victor Talking Machine Co., Camden, N. J., and reinforced concrete ore trestle for the Maryland Steel Co., Sparrows Point, Md.

The Bessemer Limestone Co., Youngstown, O., sends a wall calendar for 1915 which cannot fail to find a conspicuous place in any office receiving it.

The International Engineering Congress will be held in connection with the Panama-Pacific Exposition at San Francisco, September 20-25. Memberships and subscriptions to the volumes of proceed-

ings are now being received by the secretary of the congress, Foxcroft Building, San Frnacisco, Cal.

Marconi trans-oceanic wireless telegraph is now in successful operation between San Francisco and Honolulu and has caused a reduction in cable rates to the basis of its own rate of 25 cents a word.

The F. D. Cummer & Son Company have just been awarded contract by the Boro of the Bronx, New York City, for a Cummer road plant with a guaranteed capacity for turning out 750 square yards of 2-inch top asphalt macadam or Topeka mix per day. This plant is to be erected ready for operation in the early spring.

The MacArthur Concrete Pile & Foundation Company, New York, has been awarded contracts for the foundation of the boiler house at the Portland (Me.) Gas Light Company plant; for pedestal concrete pile foundation for the State Hospital laundry building, Toledo, Ohio; for concrete piles required for the bridge over the Susquehanna river at Nanticoke, Pa.; for the foundation of the United States government post office building, Augusta, Ga. Waldo Bros., 45 Batterymarch street, Boston, Mass., have been appointed their sales agents for New England.

The Westport Paving Brick Company of Baltimore, Md., and the Mack Manufacturing Company of New Cumberland, W. Va., have become licensees of the Dunn Wire-Cutting Brick Company for the manufacture of wire-cut-lug paving brick.

Trade Publications

Ornamental concrete lighting standards for artistic illumination of business and residential streets, parks, private grounds, etc., are handsomely illustrated in a circular of Morrison & Quinn, manufacturers, Rochester, N. Y.

Connersville cycloidal pumps are the subjects of Catalog 16 of the Connersville Blower, Co., Connersville, Ind.

The Society for Electrical Development has prepared a booklet on electricity in the home, which can be used by its members as advertising literature to promote the use of the many household appliances now on the market.

A new booklet on "Disposal of Waste by Fire" can be obtained of the Atkinson-Morse Destructor Co., 30 Church street, New York City.

The American Rolling Mill Co., Middletown, O., sends a booklet of reproductions of letters giving expressions of the estimate placed on Armco-American ingot iron by those who are using it, which demonstrates the popularity and success of this specially pure iron for the purposes described.

The American Telephone Fire Alarm Co. has developed a fire-alarm system which is revolutionizing the alarm section of fire prevention. Its simplicity and ease of operation and maintenance are unsurpassed. It is described in full in the publications of the company, which will be sent on request from their office, 10 South La Salle street, Chicago, Ill.

Catalog 805 of the Studebaker Company is devoted to bottom dump wagons and dump boxes, of which this company makes a line which has long been the standard. The catalog goes into full detail of all parts and all designs and styles, and will be sent on application to the company at South Bend, Ind., or to any of its numerous branches.

A treatise on steam boilers and boiler feed water is issued by the American Boiler Life Co., Boston, Mass.

The Armco Culvert Publicity Bureau, 2101 Union Central Life building, Cincinnati, O., publishes an excellent article on "Corrugated Iron Construction on the Sacramento Valley Irrigation Project," which is by Eugene C. Mills, engineer of the Sacramento Valley Irrigation Co., which will be sent on request.

The Foster valve specialties of the Foster Engineering Company, Newark, N. J., are fully shown, listed and priced in Catalog No. 20.

Indiana Limestone, "the aristocrat of building materials," is the title of a handsome descriptive booklet, fully illustrated, issued by the Indiana Limestone Quarrymen's Association, of Bedford and Bloomington, Ind.

Sauerman Bros., Chicago, Ill., issue a fully-illustrated booklet on the Shearer and Mayer dragline cable way excavator, which seems to be one of the most popular of the excavators of this type now on the market.

The Harris Patents Company, New York, issue a catalog of a valveless engine which has some points of notable advantage.

The monthly publication of the Sandusky Portland Cement Co., always has descriptions and photographs of interesting architectural and engineering works in which Medusa portland or white cement has been used.

Willis Shaw Machinery Co., New York Life building, Chicago, Ill., publish a semi-annual booklet of second-hand machinery which they have for sale.

The Burt Portland Cement Co., Bellevue, Mich., publish daily tests of their cement for a week in August, which show some remarkable results as to uniformity.

G. H. Atkinson Co,, New York, issue an illustrated description of a nesting galvanized street cleaning can and a push cart or can carrier for the use of the street cleaner with broom or brush and pan or shovel.

A new folder shows the latest product of T. L. Smith & Co., Milwaukee, the Smith mixerette, which takes a batch of 5 cubic feet of loose sand, stone and cement and mixes 40 to 60 cubic yards of concrete per day.

It required a panoramic photograph 6 by 36 inches, crowded full of faces, to show those present at the general sales conference of the Goodyear Tire and Rubber Co., at Akron, O., on October 30.

A recent booklet of the Sandusky Portland Cement Co., Sandusky, O., is a handsomely illustrated demonstration of the wide and successful use of Medusa waterproofing, manufactured by this company for The Medusa Waterproofing Co.

Catalog 58 B of The Van Dorn Iron Works Co., Cleveland, O., is a fully illustrated exposition of their systems of steel jail and prison cells, keyless locking device for sliding cell doors and interlocked and counterlocked grating construction.

G. H. Atkinson Co., 30 Church St., New York, have a new circular regarding their "Torpedo" scarifier for road surfaces.

The Koehring Machine Co.'s Chicago district manager is out with a hurry-up circular on "War with the Elements," giving the advantages of hurrying up fall work with a Koehring mixer.

The United States Tent & Awning Company, Chicago, has a new catalog and price list of all sorts and sizes of tents, balloons, chairs, seats, benches, tables, lights, cots, flags, oiled clothing and other goods for outdoor use.

The embargo on crude rubber from English possessions has been raised thru negotiations with the English government by the government of the United States and representatives of the manufacturing companies, and new shipments have begun to arrive, with consequent reduction in price of rubber and protection of prices for tires.

The Sandusky Portland Cement Company, Sandusky, Ohio, is distributing an edition in Spanish of its booklet on Medusa White Portland Cement.

A booklet illustrating and describing the processes of making Youngstown quality pipe, lap and butt welded wrought iron, is issued by the Youngstown (Ohio) Sheet and Tube Company.

The Van Dorn Iron Works Company, Cleveland, Ohio, have at least two lines of manufacture of interest to public officials. One of these is their patent prison and cell construction, using their toolproof steel; another is strong and ornamental fencing for parks, enclosures for animals, bear pits, etc., some of which have been illustrated in MUNICIPAL ENGINEERING. Catalogs and booklets on each line will be sent on request.

Small destructor furnaces for disposing of the wastes from hospitals, department stores, factories, private estates and small cities and towns are built by the Atkinson-Morse Company, 30 Church streets, New York City, who will send booklets descriptive of the same on request.

The Buckeye Engine Company, Salem, Ohio, issue a booklet about their compact steam engine and boiler for contracted space. They claim for their designs of power plants half the coal, half the floor space and half the labor of many other steam plants. They also make gas engines and the Buckeye-mobile.

Much of the Grinnell Automatic Sprinkler Bulletin for January is taken up with the story of the fire in the Edison plant and how it might have been saved by the use of automatic sprinklers.

The Reid incinerator is briefly described in a booklet by the A. H. Reid Incinerator Company, 69 Rowanwood avenue, Toronto, Ont.

Clifford Richardson, New York, has published in a booklet a brief article on "Stone-Filled Asphalt Surface or Fine Asphalt Concrete."

The Koehring mixer booklet for January has been received from the Koehring Machine Company, Wilwaukee, Wis.

The Universal Portland Cement Company, Chicago, Ill., publishes a handsomely illustrated series of booklets on Concrete Roads which gives much valuable information.

Standard reinforced spiral pipe is detailed in catalog No. 4 of the Standard Spiral Pipe Works, Chicago, Ill.

The Blackmer & Post Piper sounds the merits of Blackmer & Post vitrified pipe, made in St. Louis, Mo.

The Red Book of the United States Gypsum Company, Chicago, Ill., will be mailed on request to any one wishing full, authoritative information on gypsum and its products, such as wall plaster.

Studebaker catalog 914 describes street sprinklers and sweepers, of which this company makes a standard line.

DeLaval centrifugal pumps, single and multiple stage, for all capacities and heads, are fully detailed in catalog B of the DeLaval Steam Turbine Company, Trenton, N. J., which sets forth their characteristics, design, manufacture, testing, selection and adaptation to various uses. Thre are special chapters on speed-reducing gears and turbine-driven water works pumps.

The third annual message of Rudolph Blankenburg, mayor of Philadelphia, and the department reports take three volumes, the first covering public safety and the civil service commission; the second public works, clocks and city transit; and the third, public health, supplies and other departments. The report just issued is for the year 1913.